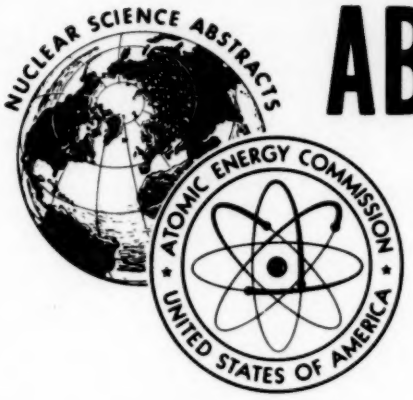
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 2

Abstracts 2428-5835

July 31, 1974

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Volume 30, Number 2, July 31, 1974

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
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SMITH, J., See HOEGERMAN, S.F., 29:13035
See HOEGERMAN, S.F., 29:13037

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REACTOR MATERIALS/STRESS ANALYSIS
Problems on nuclear reactor structure at elevated temperature, 29:14654
REACTOR PROTECTION SYSTEMS
HTGR gas turbine power plant control and safety studies. Quarterly progress report for the period July 1, 1973--September 30, 1973, 29:14846 (GULF-GA-A-12799)

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. **(USAEC Division of Controlled Thermonuclear Research, Washington, D. C.).** 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

is indexed as:

USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
CTR engineering systems study review meeting, Germantown, Maryland, September 19 and 20, 1973, 29:14452 (WASH-1278)

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Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 30, Number 2 July 31, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

2428 NEW CLASSIFICATION OF THE ELEMENTS. Perrin, F. Sci. Avenir; No. 324, 193-195(Feb 1974). (In French).

The new table presented by F. Perrin for classifying elements meets the following requirements: enables the concept of recurrent chemical properties to be completely explained; contains all the chemical elements expressed in terms of increasing atomic number; does not contain any interruption in the lines or columns. The arrangement suggested fulfills these three principles. (FR)

Analytical and Separations Chemistry

Refer also to abstracts 3214 and 5804.

2429 (UCID-15644-73-4) ANALYTICAL CHEMISTRY QUARTERLY REPORT, OCTOBER-DECEMBER 1973. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1974. Contract W-7405-eng-48. 73p. Dep. NTIS $6.75.

The outgassing rate of explosive 9404 was measured on high-density bulk pieces of the material. Methods of reducing the outgassing are being investigated. Energy-dispersive x-ray spectrometry was developed for the analysis of boron carbide for trace amounts of the elements Ca through Mo, and the refractory elements such as Ta, W, and U. Arc-temperature measurements are reported for graphite-charged electrodes arced in Ar, Ar-CO, He, and He-CO, and for MoO_3-layer electrodes arced in Ar and He. Some levels of the neutral atom configuration $5f^n7s8s$ were found for Cm (n = 8), Bk (n = 9), Cf (n = 10), and Es (n = 11). A guide for the assay and isotopic analysis of Pu in PuO_2 was completed, and a draft forwarded to the Materials Protection Standards Branch of the Directorate of Regulatory Standards. A constant-current source that is computer-controllable was designed and constructed for use in the automated coulometric titration system for the determination of uranium. (JGB)

2430 BIOLOGICAL MATRIX STANDARD REFERENCE MATERIALS FOR TRACE ELEMENT DETERMINATIONS. LaFleur, P. D. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 19: No. 2, 227-232(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Two new biological standards SRM-1571 (orchard leaves) and SRM-1577 (bovine liver) are being distributed by the NBS as reference material (SRM). The concentration of a number of elements in trace amounts were certified in these materials. The preparation and the analytical program for these standards are described. The great interest in such standards will assure a quality control and permit the development of new procedures for the analysis of biological standards. (tr-auth)

2431 ORGANIC ELEMENTAL ANALYSIS. Ma, T. S. (City Univ. of New York, Brooklyn); Gutterson, M. Anal. Chem.; 46: No. 5, 437R-451R(Apr 1974).

This review covers the period October 1971 to November 1973. Developments in the determination of the elements in organic materials are covered. Elements covered are carbon, hydrogen, nitrogen, oxygen, halogens, sulfur, phosphorus, and arsenics. Sections on organometallics, multi-element analysis, submilligram samples, and trace analysis are included. (345 references) (LK)

2432 REVIEW OF METHODS FOR THE DETERMINATION OF OSMIUM AND RUTHENIUM. Faye, G. H. J. S. Afr. Chem. Inst.; 25: No. 3, 311-319(Feb 1972).

Although the current demand for osmium and ruthenium metals is low, industrial and research laboratories which are concerned with the analysis of platiniferous materials of a mineralogical or metallurgical nature, must be prepared to determine these elements at least on an occasional basis. Although many laboratories have adequate methods for the determination of gold, silver, platinum, palladium, rhodium, and possibly iridium, there are aspects of the analytical chemistry of osmium and ruthenium which may not be familiar to some workers. This review deals with some of these matters; it reflects the interests of the author and is not intended to be exhaustive. (INIS)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 2842, 3187, 3436, 3576, and 4892.

2433 (CEA-R-4568) MICROANALYSIS STUDIES THROUGH THE DIRECT OBSERVATION OF NUCLEAR REACTIONS. Application to Measurements of the Surface Concentration Gradients of Light Elements in Solids. Golicheff, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1974. 183p. (In French). Dep. NTIS (US Sales Only) $12.25.

Thesis. Submitted to Paris Univ., Orsay.

Two methods for the analysis of light elements at the surface of solids by the direct observation of nuclear reactions are compared. The first method is based on the detection of prompt γ photons emitted in resonant reactions. The second method involves the detection of charged particles. The usefulness of the first method for determining the following light elements, Li, Be, B, C, N, O, and F, using (p,γ) and $(p,\alpha\gamma)$ reactions, was studied. The photon emission yield curves most characteristic of these elements were determined and the intrinsic sensitivities obtainable subsequently deduced. The excitation functions of the ^7Li (p,α_0) ^4He, $^{19}F(p,\alpha_0)$ ^{16}O, ^{12}C (d,p_0) ^{13}C, $^{14}N(d,p_1)$ ^{15}N + $^{14}N(d,p_2)$ ^{15}N, $^{14}N(d,\alpha_0)$ ^{12}C and $^{14}N(d,\alpha_1)$ ^{12}C reactions were determined for an angle of observation of 150°. Various examples of the application of these methods are cited. (auth)

2434 (CONF-740608-10) SENSITIVITIES IN ^{252}Cf NEUTRON ACTIVATION ANALYSIS. Ricci, E. (Oak Ridge National Lab., Tenn. (USA)). [nd.]. 4p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

Interference-free sensitivities for Na, Al, Si, V, Mn, Fe, Co, Zn, As, Se, Mo, Cd, Eu, Hg, and Pb were determined in a ^{252}Cf neutron activation analysis system which is comprised of three ^{252}Cf sources surrounding a central irradiation hole in a polyethylene cylinder submerged in a water pool. (LK)

2435 (FRNC-TH-486) NEW METHODS FOR ANALYZING IMPURITIES IN BORON. Purification of Molten Boron by Electron Bombardment. Viala, J. C. (Lyon-1 Univ., 69 (France)). 1973. 116p. (In French). Dep. NTIS (US Sales Only) $9.00.

Thesis.

In the first part of the thesis, new techniques are exposed for analyzing impurities in boron: spark mass spectrometry for the analysis of boron fibers and bulk boron; atomic absorption spectrometry for the determination of average K, Na, Ca, Mg, Mn, Ni, Cu, Fe, and Cr contents; activation analysis (54 MeV α par-

ticles) for the determination of oxygen in bulk boron; utilization of direct observations made of nuclear reactions induced by low-energy deuterons to analyze oxygen and carbon in thin boron films; surface oxygen analysis by elastic proton scattering; analysis of thin boron films by detecting x-rays induced by proton bombardment. Electron bombardment melting is considered in the second part of this thesis. The analytical methods presented enable the purification of boron by simple melting, evaporation, recondensation on a cold substrate, and zone melting (horizontal and vertical) to be studied. The conditions under which a monocrystal can be prepared are given together with the impurity distribution coefficients of zone purified boron. (FR)

2436 (IJS-R-617) RAPID NEUTRON ACTIVATION ANALYSIS OF ARSENIC IN A WIDE RANGE OF SAMPLES BY SOLVENT EXTRACTION OF THE IODIDE. Byrne, A. R.; Vakselj, T. (Nuklearni Inst. Jozef Stefan, Ljubljana (Yugoslavia)). Dec 1973. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

A method is described for neutron activation analysis of arsenic in biological samples, inorganic matrices, water samples and metals based on the quantitative and selective solvent extraction of arsenic iodide into toluene. Depending on the sample, extraction is made from sulfuric, perchloric, or hydrochloric acids containing alkali iodide. After a single washing stage, and an optional stripping back into aqueous medium, measurement of the 0.56 MeV γ-ray of ^{76}As is made with a well-type 3 × 3 inch NaI(Tl) crystal and multichannel analyzer. For moderate neutron doses (20 h at 2×10^{12}n cm^{-2} sec^{-1}) levels down to 0.1 ng/g may be measured. Results are presented for samples including some international standard materials. (auth)

2437 (IJS-R-619) SIMULTANEOUS NEUTRON ACTIVATION ANALYSIS OF SELENIUM WITH MERCURY IN BIOLOGICAL SAMPLES BY VOLATILIZATION. Byrne, A. R.; Kosta, L. (Nuklearni Inst. Jozef Stefan, Ljubljana (Yugoslavia)). Jan 1974. 22p. Dep. NTIS (U. S. Sales Only) $4.25.

A method is described for the determination of selenium together with mercury in biological samples by neutron activation analysis based on quantitative volatilization of both elements. The technique, originally developed for mercury, based on pyrolysis together with filtration of undesirable impurities and selective trapping in the gas phase, is now extended to selenium. Both radionuclides, ^{197}Hg and ^{75}Se, from one sample are separately trapped and measured in a well-type NaI(Tl) detector and γ spectrometer for maximum sensitivity. The method was tested by comparative analyses and analyses of standard biological materials, and gives good results. It is simple and is especially effective in studies of the interaction of mercury and selenium in biological systems; a positive correlation of these elements was found in human tissues. (auth)

2438 (JINR-P12-6810) THERMAL AND EPITHERMAL NEUTRON ACTIVATION ANALYSIS ON THE IBR-30 REACTOR. Ngo Kuok Byu; Vyropaev, V. Ya.; Fam Kuang Dien; Zhuravleva, E. L.; Fam Zui Khien. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 14p. (In Russian). INIS.

For activation analysis on the IBR-30 reactor two channels and a sample loading-unloading installation were installed. The first channel has thermal neutrons and the second epithermal. The physical parameters of both channels were measured and the sensitivity of the analysis of some elements in both the thermal and epithermal neutron beam was determined. A clear advantage of activation with epithermal neutrons was shown for elements having a large resonance activation interval (Au, In, Cs, U, Ta, etc.). The measurement of the γ spectra was done with a Ge(Li) detector and the AI-4096 analyzer. (tr-auth)

2439 (RCN-208) DETERMINATION OF ALUMINUM IN BLOOD BY ACTIVATION ANALYSIS. Galenkamp, H.; van Leeuwen, J.; Das, H. A. (Stichting Reactor Centrum Nederland, Petten). Feb 1974. 18p. Dep. NTIS (U. S. Sales Only) $4.00.

Determination of aluminum in blood by chemical separation and neutron activation analysis is described. The lower limit of the method is ≈0.2 μg/ml using a sample of 5 ml. Some data for human and animal blood and for standard kale powder are given. (auth)

2440 (UJV-3163-Ch) DETERMINATION OF LANTHANUM IN STEEL AND SLAG BY THE ACTIVATION ANALYSIS METHOD. Zapletal, L.; Kukula, F.; Vinsh, V. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Oct 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The use of an inactive tracing method in metallurgy of iron has been described, particularly for the research of wearing-out the furnace brick-lining and for the determination of its influence on the quantity of nonmetallic material in iron. Lanthanum oxide has been used as indicator. After the studied process had been finished, the activation method for the determination of lanthanum has been used. The chemical separation of lanthanum has been based on its repeated precipitation in the form of hydroxides and oxalates. The precision and reproducibility of the method is almost the same as in the case of the radioactive tracing technique. The use of inactive material during the very process on metallurgical plants is the most important advantage of the described method. (auth)

2441 PROCESS CONTROL FOR PROTECTION AGAINST ENVIRONMENTAL POLLUTION. Shigeta, H. (Tokyo Atomic Industrial Research Lab., Ltd., Kawasaki, Japan). Genshiryoku Kogyo; 19: No. 10, 12-16(Oct 1973). (In Japanese).

Environmental pollution is mostly due to waste water and emitted gases. The preventive measures against environmental pollution must be taken both outside and in enterprises (including employees). The utilization of radioactivation analysis and activable tracer method for this process control was described. First of all, the sensitivity of each element by radioactivation analysis, detection sensitivity of harmful elements by radioactivation analysis, and detection sensitivity of elements which might become an issue in the future when using these two methods were shown. In order to analyze heavy metals in waste water, elements in 10 to 20 ml of sampled waste water were analyzed and compared with control values. In order to know efficiency of an apparatus and an equipment and leak of water, it is better to utilize activable tracer method. On this occasion, tracer, of which radioactivation analytical sensitivity is high, is used. Radioactivation analysis and tracer technique can be used in testing efficiency of waste water treatment apparatus. There is a sulfur analyzer using radiation, which is indispensable in sulfur analysis, as an analyzer used in controlling emitted gases. Analysis of heavy metals in petroleum is easy without destruction by radioactivation analysis. Furthermore, measurement of mercury by the isotope dilution method using radioisotopes was especially explained in order to prevent pollution due to mercury which is one of the big social problems at present. As rules for health management of workers engaged in harmful jobs, there are working environment, working hours, and medical examinations. At the same time, control of harmful element concentrations in the air at the working place where harmful elements are treated is carried out. Health management is also easy by radioactivation analysis. Besides, not only mercury but also cadmium, arsenic, etc. can be analyzed by radioactivation analysis. (JA)

2442 (n−α) RADIOGRAPHY IN THE DETERMINATION OF B IN PRESERVED WOOD. Dubinskaya, N. A.; Tsel'millere, M. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 3-10(1973). (In Russian).

The possibility of applying the (n−α) radiography for determination of B in preserved wood using the nitrocellulose track detectors was studied. The detection limit of B in wood for a neutron flux of $2 \cdot 10^9$ to $1 \cdot 10^{12}$ n/cm^2 was found to be $(200-8) \cdot 10^{-6}$ g B/cm^3. (auth)

2443 ACTIVATION ANALYSIS FOR TRACE TELLURIUM IN ROCKS BY EXTRACTION OF THE DAUGHTER NUCLIDE. Lavi, N. (Soreq Nuclear Research Centre, Yavne, Israel). Anal. Chim. Acta; 70: 199-202(1974).

Thermal neutron activation of ^{130}Te gives two products: ^{131m}Te and ^{131}Te. The ^{131}Te decays to ^{131}I. Therefore, the iodine activity extracted from the sample is proportional to the amount of tellurium which was irradiated. Iodide is first oxidized to iodate with permanganate acidic solution, and iodine is formed by treatment with hydroxyammonium chloride and extracted with carbon tetrachloride. Backextraction with water containing sodium pyrosulfite and ammonia (to prevent precipitation of Ag_2SO_3) produces iodide, which is precipitated as silver iodide and counted with a Ge(Li) detector, in order to ascertain the purity of the separated ^{131}I. (LK)

2444 ACTIVATION ANALYTICAL METHODS FOR THE GRADING OF SEMICONDUCTOR CRYSTALS. Szabo, E. (Central Research Inst. for Physics, Budapest). J. Radioanal. Chem.; 19: No. 1, 23-32(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The analytical requirements for the fabrication technology and the analysis results within the body of the crystal, at the surface, and the surface layers of Si and gallium arsenide are discussed. Techniques are given for the routine detection of Au, Cu, As, Sb, W, and Na in semiconductor-grade Si and of Al, Si, Cr, Zn, Se, Te, Fe, Co, and Hg in gallium arsenide. (JSR)

2445 ANALYSIS OF Se BY NEUTRON RADIOACTIVATION. Application of Ion Exchange Chromatography on Resins to the Systematic Analysis of Se. Mignonsin, E. P. (Univ., Liege). J. Radioanal. Chem.; 19: No. 1, 33-43(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The proposed method applies systematically chromatographic separations on ion exchange resins to the analysis of impurities in Se. After dissolution in a mixture of hydrofluoric and nitric acids the method separates, on columns of Dowex I, X-8, resin of 200 to 400 mesh, the radioisotopes into three large groups, each containing 12 to 14 elements. Different eluants complete the separation within each group. The method was applied to the analysis of Se samples of different purity. (tr-auth)

2446 ANALYSIS OF RARE METALS AND SEMICONDUCTOR MATERIALS BY ACTIVATION WITH HELIONS-3 AND THERMAL NEUTRONS. Aleksandrova, G. I.; Shmanenkova, G. I.; Shchulepnikov, M. N.; Kondratiev, L. G.; Glukhov, Yu. A. (Commission of Atomic Energy, Moscow). J. Radioanal. Chem.; 19: No. 1, 65-75(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Methods for the determination of O and C in some refractory metals and semiconductor materials are presented. Particular attention is given to surface treatment processes before and after irradiation and to methods for the separation of radiochemically pure F_2 and C. For the determination of Cu, Mn, Co, Ni, Cu, and Zn the impurities are concentrated and separated by extraction chromatography. Possible uses of extraction chromatography in activation analysis of high-purity materials are discussed. (tr-auth)

2447 ACCURATE DETERMINATION OF Ga IN Ga_xSe_y BY MEANS OF NEUTRON ACTIVATION: A COMPARISON WITH X-RAY FLUORESCENCE AND WET CHEMICAL METHODS. Bruninx, E. (Philips Research Labs., Eindhoven, Netherlands). J. Radioanal. Chem.; 19: No. 1, 47-53(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

For the exact determination of Ga in Ga–Se compounds, the preparation of the samples, the irradiation, the method for the measurement of the activity, and the calculation of the results were studied in succession. It is shown that the error is of the order of 0.1% of the concentration in Ga. The systematic errors and the causes of imprecision are examined. (tr-auth)

2448 DETERMINATION OF 12 SELECTED MICROELEMENTS IN AIR PARTICLES BY NEUTRON ACTIVATION ANALYSIS. Schramel, P.; Samsahl, K.; Pavlu, J. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Munich). J. Radioanal. Chem.; 19: No. 2, 329-337(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Neutron activation analysis combined with a radiochemical separation is used for the determination of the elements As, Br, Cd, Co, Cr, Cu, Hg, La, Sb, Se, Sn, and Zn in dust samples. Sampling is done once each month by a "fall-down method" in polyethylene bottles. (tr-auth)

2449 NEUTRON ACTIVATION ANALYSIS OF SOLID ATMOSPHERIC CONTAMINANTS WITH AN INTERNAL STANDARD TECHNIQUE. Belot, Y.; Marini, T. (Departement de Protection Service de Recherches Toxicologiques et Ecologiques, Paris). J. Radioanal. Chem.; 19: No. 2, 319-327(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A nondestructive technique is described which allows the determination of about 20 elements in atmospheric particles collected on filters. On unknown samples a known quantity of Rb is deposited and the Rb serves as an internal standard. The unknown sample and the reference standard are irradiated under the same conditions for several days in a thermal neutron flux and then counted with a Ge(Li) detector. The advantages and limitation of the internal standard technique are discussed. (tr-auth)

2450 RESULTS FROM MULTI-TRACE-ELEMENT NEUTRON ACTIVATION ANALYSES OF MARINE BIOLOGICAL SPECIMENS. Guinn, V. P.; Kishore, R. (Univ. of California, Irvine). J. Radioanal. Chem.; 19: No. 2, 367-371(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A large number of marine biological specimens extending from seaweed to the tunny, to the swordfish, and to marine mammals were analyzed in order to evaluate the Hg, Se, and Zn content by thermal neutron activation with use of a Ge(Li) spectrometer. Under these conditions concentrations as low as 0.01 ppM of Hg, 0.02 ppM of Se, and 0.2 ppM of Zn can be detected. The results obtained for dolphins, whales, and albacore are described. (tr-auth)

2451 DETERMINATION OF TRACE METALS AND FLUORIDE IN MINERALOGICAL AND BIOLOGICAL SAMPLES FROM THE MARINE ENVIRONMENT. Bressan, D. J.; Carr, R. A.; Hannan, P. J.; Wilkniss, P. E. (Naval Research Lab., Washington, DC). J. Radioanal. Chem.; 19: No. 2, 373-381(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Metal and fluorine traces in atmospheric dusts collected over different oceans were studied by activation analysis. Neutron activation was used for the metal analysis and photon activation for F determination. The importance of the results obtained for Hg and F as a function of the environment was discussed in detail. The study of the extraction yield for Hg was done in the laboratory using the marine algae phaeodactylum tricornutum. During preliminary studies using ^{197}Hg as a tracer different experimental parameters were evaluated. The final results for Hg concentration in algae were compared with those obtained by atomic absorption analysis. (tr-auth)

2452 DETERMINATION OF HAFNIUM IN STANDARD REFERENCE MATERIALS USING BIS(2-ETHYLHEXYL)PHOSPHATE (HDEHP) WITH NEUTRON ACTIVATION ANALYSIS. Gills, T. E.; LaFleur, P. D. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 19: No. 2, 235-237(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The method for determination of Hf in steel standards is described. This method consists of a combination of neutron activation analysis and a solvant extraction procedure. The extraction agent was bis(2-ethylhexyl)phosphate. In turn Hf was reextracted with 2N HF just before the activity measurement. The measurement was made with a 60 cc Ge(Li) detector associated with a 2048-channel analyzer. The analysis method described allowed a rapid determination of Hf with a precision of the order of 3 to 4% for routine determinations. (tr-auth)

2453 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF AIR FILTER SAMPLES. Kuykendall, W. E. Jr.; Fite, L. E.; Wainerdi, R. E. (Texas A and M Univ., College Station). J. Radioanal. Chem.; 19: No. 2, 351-358(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The measurement of element traces in the ambient air is the object of increasing attention because of a growing interest in the health dangers resulting from prolonged exposure to some toxic substances. Neutron activation analysis was used with success in the study of element traces. The capabilities of automated instrumental neutron activation analysis are demonstrated on 40 air filter samples from a metropolitan area. (tr-auth)

2454 ACTIVATION ANALYSIS OF IMPURITY DISTRIBUTIONS IN CRITICAL LAYERS OF SEMICONDUCTORS. Rausch, H. (Research Inst. for Telecommunication, Budapest); Bereznai, T.; Bogancs, J. J. Radioanal. Chem.; 19: No. 1, 77-85(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Studies made on epitaxial layers deposited on substrates doped with As, Sb, and P are reported. The critical layers are studied by activation analysis and autoradiography. The distributions of the concentrations of the doping elements and of the most frequent impurity traces, such as Au, Cu, and Na, in the surface layers and in the film-substrate interface of the homoepitaxial layers of Si are determined. In the experimental conditions given, it is found that the minimum contaminating concentration detectable is approximately 10^{13} atoms/cm^3. (tr-auth)

2455 DETERMINATION OF FOURTEEN ELEMENTS IN PURE IRON BY DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. De Wispelaere, C.; Op de Beeck, J. P.; Hoste, J. (State Univ., Ghent). Anal. Chim. Acta; 70: 1-15(1974).

A method is presented for the determination of fourteen elements in pure iron by means of destructive thermal neutron activation analysis. By means of an anion- and cation-exchange procedure in 1 M hydrofluoric acid, the iron matrix is separated from a large number of elements, which are further separated in groups. W, Mo, Ta, Sn, Sb and Sc are found and measured as one group on the anion-exchange resin. Cu and Co, and Zn and Ag, are two groups obtained from the cation exchange procedure. For the elements Ga, Ni, Cr and As which cannot be included in the general group separation scheme, special individual methods are described. (auth)

2456 APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE INVESTIGATION OF NATURAL AND POLLUTION AEROSOLS. Winchester, J. W. (Florida State Univ., Tallahassee). J. Radioanal. Chem.; 19: No. 2, 311-317(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Use of neutron activation analysis to obtain data on metal traces found in polluted atmospheric samples is considered. These data should lead to an effective control of the pollution. Five papers at the Colloquium are discussed as examples of the nature of studies on air pollution, the improvement of analytical techniques to meet the needs relative to application to the environment, and the comparison of associated techniques. Studies by the author are then taken as examples of the different application which can be made of activation analysis for the study of metallic traces in urban atmospheres. (tr-auth)

2457 INVESTIGATION OF THE CORROSIVE DEPOSITION OF COMPONENTS OF METAL IMPLANTS AND OF THE BEHAVIOR OF BIOLOGICAL TRACE ELEMENTS IN METALLOSIS TISSUE BY MEANS OF INSTRUMENTAL MULTI-ELEMENT ACTIVATION ANALYSIS. Lux, F.; Zeisler, R. (Technische Univ., Munich). J. Radioanal. Chem.; 19: No. 2, 289-297(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The behavior of the elements of steel V4A in tissues intoxicated by the metals was studied by activation analysis. V4A consists of Fe, Cr, Ni, Mo, and Mn with trace elements of Co, Zn, and Sb. Ag and Ta were treated as pure metal implants. For the study of Mn ^{24}Na was separated radiochemically. The detection limits lay between 0.005 ppM (Ta) and 5 ppM (Fe). From the analysis results it was deduced that a process of transcrystallin intercellular corrosion of the materials implanted occurred followed by a rapid disappearance of the simple constituents. Only Fe was accumulated in the cells in the form of a biological compound that was degraded slowly. The Zn content, an essential trace element, was remarkably decreased in the tissue. The decrease can be a consequence of the displacement of Zn bound to enzymes by the implanted constituents causing changes in the enzymatic processes which play a determinant role in the development of metallic intoxication. (tr-auth)

2458 ACTIVATION ANALYSIS OF MICROQUANTITIES OF ELEMENTS IN BIOLOGICAL MATERIALS. Kist, A. A.; Khatomov, Ch.; Krygenkova, N. A. (Commission on Atomic Energy, Moscow). J. Radioanal. Chem.; 19: No. 2, 277-287(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Examples are given of the activation analysis in the biogeochemical study of Au, in the differential analysis of eye tissues, in the determination of residual amounts of pesticides, in the study of small modifications in the concentration of microquantities of elements during research with the preliminary mineralization of materials. An evaluation is given of the precision of the analysis. (tr-auth)

2459 RAPID NEUTRON ACTIVATION OF BROMINE USING 6.1-MINUTE BROMINE-82M: APPLICATION TO THE DETERMINATION OF BROMINE IN BLOOD PLASMA. Peisach, M. (Southern Universities Nuclear Inst., Faure, South Africa); Maziere, B.; Loc'h, C.; Comar, D.; Kellershohn, C. J. Radioanal. Chem.; 19: No. 2, 269-275(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A rapid method for the determination of Br in blood plasma by neutron activation was described. By x-spectrometric measurement of ^{82m}Br the analysis of 10 μl plasma samples can be made in 10 min. In the presence of large quantities of Na and Cl as in normal plasma, the smallest quantity of Br detectable is about 5 ng. Aside from the statistical errors the experimental error introduced a margin of uncertainty of about ±2%. The advantages of different detectors used were compared. (tr-auth)

2460 DETERMINATION OF Zn AND Cu IN PERIPHERAL NERVES OF RATS NEUROPATHOLOGICALLY AFFECTED BY CARBON DISULFIDE. Kotas, P.; Obrusnik, I.; Lukas, E.; Krivanek, M. (Institut des Recherches de la Radiocommunication, Prague). J. Radioanal. Chem.; 19: No. 2, 263-268(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Activation analysis was applied to the determination of Zn and Cu in the peripheral nerves of rats exposed to CS_2. The dissected nerves were irradiated with neutrons and mineralized by wet methods. Zn and Cu were extracted simultaneously by a solution of dithizone in CCl_4. The results showed the significant increase in the Cu content in the peripheral nerves of rats exposed to CS_2, whereas the change in the Zn content was not significant. (tr-auth)

2461 DETERMINATION OF SODIUM AND POTASSIUM IN THE NUCLEI OF SINGLE NEWT OOCYTES. Whitley, J. E. (Scottish Universities Research and Reactor Center, Glasgow); Muir, C. J. Radioanal. Chem.; 19: No. 2, 257-262(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The age-connected retraction and extension of chromosome loops of amphibians can be related to the quantity of alkali metal in the eggs containing them. For the atomic absorption analysis made previously the nucleoplasm had to be extracted from 50 eggs in order to obtain a quantity of material sufficient to make precise determinations. The high sensitivity of neutron activation analysis and the avoidance of the introduction of significant blank levels of the element to be determined makes it possible to analyze one nucleus at a time. Na and K were determined in individual oocyte nuclei as a function of the oocyte diameter. The methods for determination of the two elements are described. Results were compared with those from the atomic absorption method. (JSR)

2462 ACTIVATION DETERMINATION OF IODINE IN THYROID FOLLICLES. Riviere, R.; Camuzzini, G. F.; Girault, M.; Stulzaft, O.; Comar, D. (Service Hospitalier Frederic Joliot, Orsay, France). J. Radioanal. Chem.; 19: No. 2, 245-256(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

After removal of thyroid tissue from man, the follicles which represent the functional units of the thyroid gland can be dissociated because of the action of collagenase on the conjunctive tissue. Among the numerous follicles analyzed, the smallest, less than 100 μ in diameter and weighing about 0.5 μg, contained iodine quantities less than 0.5 ng. The neutron activation analysis permitted the determination of these microquantities in a satisfactory manner. In the case of a nodular goiter removed after isotopic equilibrium had been realized for a year with ^{129}I, ^{127}I and ^{129}I were determined simultaneously. The results obtained on normal thyroid tissue or tissue from endemic, diffuse, or nodular goiters were discussed. If the glands were labeled before removal with ^{125}I, the variations of the specific radioactivity of ^{125}I contained in the follicles were analyzed as a function of their size. (tr-auth)

2463 ANALYSIS OF BIOLOGICAL AND ENVIRONMENTAL SAMPLES FOR LEAD BY PHOTON ACTIVATION. Lutz, G. J. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 19: No. 2, 239-244(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The photonuclear reaction ^{204}Pb(γ,n)^{203}Pb was used to determine Pb in biological and environmental samples. By using samples already standardized for Pb by other methods, the precision of the measurements could be evaluated. By using a careful chemical separation after the irradiation the quantity limit detected was of the order of tens of ng. (tr-auth)

2464 LITHIUM DETERMINATION BY THE NUCLEAR TRACK TECHNIQUE. Carpenter, B. S. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 19: No. 2, 233-234(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The nuclear track technique was used to determine Li in the standard reference materials 1571 (orchard leaves). In order to determine the Li concentration the tracks produced in cellulose nitrate by the α particles resulting from the bombardment of Li by thermal neutrons ^{6}Li(n,α)^{3}He were counted. (tr-auth)

2465 CADMIUM BY IN VIVO NEUTRON ACTIVATION ANALYSIS. Biggin, H. C.; Chen, N. S.; Ettinger, K. V.; Fremlin, J. H.; Morgan, W. D.; Nowotny, R.; Chamberlain, M. J.; Harvey, T. C. (Univ. of Birmingham, Eng.). J. Radioanal. Chem.; 19: No. 2, 207-214(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The presence of Cd in man can be determined in vivo by the neutron activation technique. The capture of thermal neutrons by ^{113}Cd leads to a prompt γ emission which can be detected by a suitable semiconductor. An installation was developed at the University of Birmingham for the production with a cyclotron of a pulsed neutron beam. A series of experiments was made on cadavers. These experiments proved that it is possible to detect Cd at a concentration of 2.0 ppM in the volume of a human liver for a dose of 1 rem. The results and possible applications of this study are discussed. (tr-auth)

2466 ANALYSIS OF MAN. Lenihan, J. M. A. (Dept. of Clinical Physics and Bio-Engineering, Glasgow). J. Radioanal. Chem.; 19: No. 2, 199-205(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The analysis of man, that is the study of the chemical composition of the intact human subject, is of interest (although not necessarily of importance) for the clinician and physiologist. The problem constitutes also a considerable motivation for chemists and for physicians and biologists which have undertaken recently to contribute to the development and application of analytical techniques. In vivo neutron activation analysis has been applied to the study of the composition of the whole body and a limited region of the body. The technique has numerous experimental and ethical difficulties and has obtained up to the present only limited success; but it is probably capable of being developed usefully. For several elements another approach (based on the use of tracers and in vitro activation analysis) merits a much greater attention. (tr-auth)

2467 ANALYSIS OF TRACES AT ORNL'S NEW HIGH-FLUX NEUTRON ACTIVATION LABORATORY. Ricci, E.; Handley, T. H.; Dyer, F. F. (Oak Ridge National Lab., TN). J. Radioanal. Chem.; 19: No. 1, 141-148(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

A new installation for the neutron activation analysis with a thermal flux of 5×10^{14} cm^{-2} sec^{-1} was recently installed at the ORNL high-flux reactor. This particularly high flux combined with a small computer and a program adapted to γ spectrometry with a Ge(Li) detector makes possible a shorter irradiation and a more rapid and economical identification analysis than the more conventional methods. Characteristics and operating experiences with this new laboratory and the results obtained on several types of environmental matrices for Hg, Cd, Br, As, Cl, and Na are discussed. (tr-auth)

2468 DETERMINATION OF OXYGEN IN Si AND Ge BY MEANS OF CHARGED PARTICLES. Improvement with Respect to Parasite Reactions and the Isolation of ^{18}F. Giroux, J.; Thomas, J. P. (Univ. Claude Bernard, Lyon). J. Radioanal. Chem.; 19: No. 1, 129-138(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The determination of O by radioactivation with α and ^3He charged particles was applied to Si and Ge. The operating conditions for nondestructive analysis have been made precise and the technique can be safely used for Si. A new method for the isolation of ^{18}F in the presence of interfering activities created in the matrix during the irradiation of Ge is proposed. (tr-auth)

2469 BEHAVIOR OF LIGHT IMPURITY ELEMENTS IN THE PRODUCTION OF SEMICONDUCTOR SILICON. Nozaki, T. (Inst. of Physical and Chemical Research, Saitama, Japan); Yatsurugi, Y.; Akiyama, N.; Endo, Y.; Makide, Y. J. Radioanal. Chem.; 19: No. 1, 109-128(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

By the use of charged particle activation analysis the concentration of C, N, and O in different qualities of Si for semiconductors was determined. The solubilities of these three elements in solid Si and in liquid Si at the fusion point were determined. Calibration curves were drawn for the ir spectrometry of C and O in Si. It was shown that the simultaneous use of activation analysis and spectrometry is effective for the study of the dispersion state of minimum quantities of C and O in high-purity Si. The evaporation of light impurities in melting Si was also studied with the aid of a new radiotracer technique. The behavior of C, N, and O in the production of Si for semiconductors was clarified. (tr-auth)

2470 CHARACTERIZATION OF NUCLEAR REACTOR FOR NEUTRON ACTIVATION ANALYSIS. Becker, D. A.; LaFleur, P. D. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 19: No. 1, 149-157(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Some characteristics of the NBSR nuclear reactor used for neutron activation analysis were evaluated; the measurement techniques developed were described. The characteristics considered were the thermal neutron flux absorbed by Cd and the neutron energy distribution measured from the Cd ratio and with threshold detectors. The pressure excess engendered during the irradiation of organic materials, aqueous solutions, and freeze-dried biological materials was evaluated with respect to the danger of explosion of a quartz ampule. (tr-auth)

2471 POSSIBILITIES OF INDUSTRIAL APPLICATION OF ^{252}Cf SOURCES FOR ACTIVATION ANALYSIS. Verot, J. L. (Laboratoire Central de Recherches Produits Chimiques Ugine Kuhlmann, Levallois Perret, France). J. Radioanal. Chem.; 19: No. 1, 177-183(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Some possibilities for the use of ^{252}Cf sources for industrial on-line determinations were examined. The cases of fluorine (macrodetermination) and Hf (traces) were studied. For these two very different problems, ^{252}Cf sources are capable of yielding solutions to the problems posed. (tr-auth)

2472 CONTINENTAL, MARINE, AND ANTHROPOGENIC CONTRIBUTIONS TO THE INORGANIC COMPOSITION OF THE AEROSOL OF AN INDUSTRIAL ZONE. Heindryckx, R.; Dams, R. (Univ., Ghent). J. Radioanal. Chem.; 19: No. 2, 339-349(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The concentrations and distributions of more than 30 elements in particle samples carried in air can be determined by neutron activation. This study attempts to establish the composition of the local "blank" in an industrial zone. The sampling was done when the collecting stations were not under the immediate influence of local emissions. These levels were compared with those of the actual "blank" and the natural contributions were substracted. The sampling days were chosen as a function of meteorological parameters. A superposition of the local industrial emissions was made on the local "blank." The comparison of the enrichment factors made it possible to identify the pollutants playing a significant role in the zone. The principal sources were localized by comparing, for different collection stations, the concentrations as a function of the wind direction. (tr-auth)

2473 EXACT LOCALIZATION OF FLUORINE ALONG POLLUTED NEEDLES OF ABIES ALBA BY MICROANALYSIS USING PROTONS. Garrec, J. P.; Ligeon, E.; Bontemps, A.; Bligny, R.; Fourcy, A. (CEN, Grenoble, France). J. Radioanal. Chem.; 19: No. 2, 359-365(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Nuclear reaction microanalysis was used to study the distribution of polluting elements in plants. The direct detection of the α radiation from the reaction $^{19}F(p,\alpha)^{16}O$ is a means of observing quantitatively the distribution of the fluorine accumulated by polluted needles of Abies alba. By this technique which permits the measurement of the quantity of F distributed near the surface, two distinct sites for the accumulation of F were established. One is at the necrotic point of the needle and the second is in the narrow band of tissues along the demarcation line between healthy and necrotic tissues. The distribution of the F along the needle and the contents measured differ according to the face considered. The upper face is more polluted than the lower face. The age of needles affects the amount of F accumulated. (tr-auth)

2474 TRACE ELEMENT DETERMINATION USING A HIGH YIELD ELECTROMAGNETIC ISOTOPE SEPARATOR AND NEUTRON ACTIVATION. The Determination of Cadmium. Rook, H. L.; La Fleur, P. D.; Suddueth, J. E. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 116: No. 3, 579-586(1974).

The use of isotope separators capable of producing high beam currents as applied to neutron activation analysis is discussed. The specificity of mass separation in this application allows beta or gross gamma counting to be used thereby providing increased sensitivity. The definition of instrument operational parameters and capabilities are discussed. Such parameters as yield, memory, resolution, overlap, and sputtering are considered. The optimized use of the mass separator as applied to the determination of cadmium in submicrogram quantities is presented. (auth)

2475 DETERMINATION OF IRON IN GLASS AND COBALT VIA CHARGED PARTICLE ACTIVATION ANALYSIS. Swindle, D. L.; Novak, L. R.; Schweikert, E. A. (Texas A and M Univ., College Station). Anal. Chem.; 46: No. 6, 655-658(May 1974).

Destructive and nondestructive procedures were developed for the determination of iron by charged particle activation analysis. Reaction yields on thick iron targets with proton, deuteron, helium-3, and helium-4 beams were compared. The most favorable reactions for destructive and nondestructive analysis were the $^{54}Fe(p,pn)^{53}Fe$ and $^{56}Fe(p,n)^{56}Co$ reactions, respectively. The nondestructive analyses were performed on glass while destructive determinations, including radiochemical separation, were applied to high purity cobalt. Yields from thick target experiments indicate that

Fe determinations can be made at the 50-ppB level. Activation curves for many charged particle-induced reactions on Fe are presented along with considerations of possible interfering reactions. (auth)

2476 DETERMINATION OF PHOSPHORUS IN POLLEN GRAIN WALL MATERIALS USING NEUTRON ACTIVATION ANALYSIS. Fawcett, P.; Green, D.; Shaw, G. (Univ. of Bradford, Eng.). Radiochem. Radioanal. Lett.; 17: No. 2, 121-127 (20 Apr 1974).

The phosphorus contents of pollen membranes and sporopollenins were determined using neutron activation analysis. Results indicate that pollen may be classified according to the phosphorus content of the membrane and sporopollenin. (auth)

2477 ACTIVATION ANALYSIS OF METALLIC SODIUM. Stamm, H. H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 65-69 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Trace elements in metallic sodium have been determined by means of neutron activation analysis. The impurity content of all commercial samples was in the range of several ppM and lower. The most important components were iron and zinc, but up to 70 ppM of tin was found in one group of samples. Very small amounts of cesium have been detected in "practical grade" sodium of different origins. Higher contents of chromium and iron (up to several 100 ppM) have been found in sodium from technical plants. (auth)

2478 DETERMINATION OF OXYGEN AND CARBON TRACES IN SODIUM OR CESIUM BY ACTIVATION ANALYSIS. Englemann, C.; Nordmann, F.; Tinelli, G. (CEN de Saclay, Gif-sur-Yvette, France). pp 71-75 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The methods developed and used to determine very small amounts of carbon and oxygen in sodium or cesium are described. Both these elements may be measured by bremsstrahlung activation analysis. The nuclear reactions employed are: $^{16}O(\gamma,n)^{15}O$ and $^{12}C(\gamma,n)^{11}C$. The activated oxygen and carbon thus lead to the radioisotopes ^{15}O and ^{11}C, respectively of half-lives 2.03 and 20.3 minutes, which means that the sample can be etched after irradiation to eliminate any contamination of the metal by its container or its environment. The advantage of this method is that no blank is involved if the experimental conditions, especially the maximum irradiation energy, are well chosen. The chemical separation processes used are described. Many results of oxygen and carbon determinations in sodium and cesium are given. By these methods it has been possible, for the first time so far as is known to determine oxygen and carbon concentrations as low as 0.3 $\mu g/g$ in sodium. (auth)

2479 DETERMINATION OF IRON IN ITS ORE BY NEUTRON CAPTURE γ-RAY MEASUREMENT USING AN ISOTOPIC NEUTRON SOURCE. Zaghloul, R.; Obeid, M.; Henkelmann, R. (Technische Univ., Munich). Radiochem. Radioanal. Lett.; 17: No. 1, 7-14(10 Apr 1974).

A 300 mCi $^{241}Am-Be$ neutron source was used to determine Saudi Arabian iron content in its ore using thermal neutron capture γ-ray analysis. A 3" × 3" NaI(Tl) scintillation spectrometer in conjunction with 1600-channel analyzer were used. The energy resolution of the crystal was 8% for the 662 keV γ line of ^{137}Cs. The background was improved by using ^6LiF of 450 mg/cm^2 and a 5 mm thickness of lead sheet placed in front of the crystal. The high energy γ spectrum of the iron ore sample showed the significant full energy peak of iron together with its prominent single and double escape peaks. The concentration of iron in its ore was found to be 27%. (auth)

2480 GOLD TAGGING OF ELM BARK BEETLES AND IDENTIFICATION BY NEUTRON ACTIVATION ANALYSIS. Bate, L. C. (Oak Ridge National Lab., TN); Lyon, W. S.; Wollerman, E. H. Radiochem. Radioanal. Lett.; 17: No. 1, 77-85(10 Apr 1974).

Live elm bark beetles (Scolytus multistriatus) immersed in an ethanol salt solution of 0.01 percent gold adsorb sufficient gold to be readily detected by neutron activation analysis and separated from untagged beetles by measuring the 411 KeV gamma ray of ^{198}Au. The tagged beetles when placed on elm twigs showed a survival rate of 47 percent after 12 days. With different concentrations of gold tagging solution, the average gold residue per beetle varied in direct relation, but survival rate was an inverse relation. (auth)

2481 ACTIVABLE TRACER. Shigeta, M. (Tokyo Atomic Industrial Research Lab., Ltd., Kanagawa, Japan). Radioisotopes (Tokyo); 22: No. 6, 313-321(Jun 1973). (In Japanese).

In the activable tracer technique, after a series of experiments, samples are taken and activated by neutron irradiation for intended analysis. As compared with the usual radioisotope tracer technique, it is thus less stringent with regard to regulations. Selection of suitable tracers is most important, because it determines success or failure of the method. It will be increasingly significant in future applications. The following topics are considered: principles and characteristics; selection of the tracers; principles and features of activation analysis in general; typical elements usable for the activable tracer, sensitivity and costs; cautions to be taken in the method; and instances of its application. (JA)

2482 NUCLEONICS. Lyon, W. S.; Ricci, E.; Ross, H. H. (Oak Ridge National Lab., TN). Anal. Chem.; 46: No. 5, 431R-436R(Apr 1974).

Radiochemical analysis and nuclear and atomic activation analysis are covered in this review. X-ray fluorescence analysis is reviewed in depth. A table of selected books, bibliographies, and reviews is included. (140 references) (LK)

2483 NUCLEAR METHODS IN ARCHEOLOGY. Perlman, I. pp 541-559 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Use of neutron activation analysis as a form of chemical "fingerprinting" for determining the origins of pottery is discussed. (LK)

2484 MEASUREMENT OF $^{18}O/^{16}O$ RATIO USING A FAST NEUTRON REACTOR. Jackson, H. G. (Univ. of California, Livermore); Libby, L. M.; Lukens, H. R. J. Geophys. Res.; 78: No. 30, 7145-7148(20 Oct 1973).

A method was devised and proven to measure the stable isotope ratio $^{18}O/^{16}O$ for oxygen by neutron activation in a fast neutron reactor. Measurement was made nondestructively on a few grams of water with an accuracy of a few parts in 10,000. At present, measurement to this accuracy requires about 40 min with the reactor running at a power of 250 kw, but by increasing detector sensitivity the method promises to become a routine matter accomplished in less time. (auth)

2485 NON-DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF ATMOSPHERIC AEROSOLS. Santroch, J. (Hydrometeorologicky Ustav, Prague); Obrusnik, I. Radioisotopy; 14: No. 3, 449-457(1973). (In Czech).

A method of nondestructive neutron activation analysis for the assay of atmospheric aerosols is described. Samples collected for the gravimetric determination of atmospheric dust concentration were used for the analyses. The dust was collected on membrane filter Synpor 4. The following elements were detected: (1) V, Al, Cl, Mn, Na; (2) K, La, Eu, Co, Sb, Zn, Ce, Cr, Sc, Fe, Ag, Ni. The irradiations were performed in the reactor of the Nuclear Research Institute, Řež. Short-lived radioisotopes (group 1) were irradiated for 10 min, and with the use of pneumatic transport counted within 5 min and 30 min after the irradiation. The long-lived isotopes (group 2) were irradiated for 6 hours and counted with a Ge(Li) detector cca 20 hours and 20 days after irradiation. (auth)

2486 ANALYSIS OF FLY ASHES BY NEUTRON ACTIVATION ANALYSIS. Obrusnik, I. (Ustav Jaderneho Vyzkumu, Rez, Czech.); Starkova, B. Radioisotopy; 14: No. 3, 437-447(1973). (In Czech).

The use of activation analysis for the analysis of fly ash was investigated. The purpose of this work was to establish whether neutron activation analysis can help to identify the main source of environmental contamination. The elements and conditions under which they can be determined by this method were established. Two irradiation techniques were employed, the short (10 min) and protracted (6 hours) irradiation. A nondestructive method was employed, using a semiconductor gamma spectrometer. The spectra were evaluated either manually or with the use of a computer. Twenty-five elements were found in the samples of fly ash: Al, V, Mg, Cs, Mn, Na, K, As, Cl, La, Br, Cu, Sc, W, Sb, Co, Fe, Ce, Cr, Zn, Th, Cs, Ba, Eu, and Hg. A quantitative determination was carried out for 20 elements. Samples of 25 different fly ashes were analyzed. Some samples were prepared by artificial mixing of more kinds of ashes in defined proportions to investigate which elements are best suited for the identification of contamination sources. (auth)

2487 GAMMA ACTIVATION ANALYSIS OF MINERAL MATERIALS. Randa, Z. (Ustav Nerostnych Surovin, Kutna Hora, Czech.). Radioisotopy; 14: No. 3, 415-432(1973). (In Czech).

The analytical possibilities of gamma activation analysis (GAA) are considered. Different types of GAA according to the appropriate reactions, irradiation sources, proper techniques, and experiences in the field of OGAA of mineral materials are described. (auth)

2488 PRESENT PROBLEMS OF ACTIVATION ANALYSIS. Kotas, J. (Vyzkumny Ustav pro sdelovaci Techniku, Prague); Obrusnik, I. Radioisotopy; 14: No. 3, 391-402(1973). (In Czech).

The paper deals with current problems of activation analysis and concentrates on the questions of precision and accuracy choice of standard reference materials, and possibilities for cooperation from the standpoint of Czechoslovak conditions. (auth)

2489 POLLUTION STUDIES BY THE RADIOACTIVATION OF PLANTS. Fourcy, A.; Garrec, J. P.; Neuburger, M.; Gountchev, C. (CEN, Grenoble, France). pp 81-88 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Neutron activation analysis is a useful method of establishing the existence of trace elements in plants as plant tissues are composed principally of carbon, oxygen and hydrogen and in consequence do not undergo very much neutron activation. After irradiation, the spectrum obtained represents principally oligoelements. Some analyses and interpretations on the radioecology and retention of polluting elements (mercury, pesticides, fluorine) are presented. (FR)

2490 FUNDAMENTAL STUDIES ON THE METHODS OF NONDESTRUCTIVE ACTIVATION ANALYSIS WITH 14-MeV NEUTRONS. Tamura, M.; Yamamoto, T. (National Research Inst. for Pollution and Resources, Kawaguchi, Japan). Kogai Shigen Kenkyusho Hokoku; No. 4, 1-143(Nov 1972). (In Japanese).

An equation used for the quantitative determination of elements is given. A radiation detector is 2 in. × 2 in. well-type NaI, an instrument for measuring γ energy is a 400-channel wave height analyzer, and a 14-MeV neutron generator is Cockcroft-Walton type particle accelerator. In order to determine experiment sensitivity, standard spectra, and decay curves for various elements, studies on 14-MeV neutron reaction and photoelectric peaks useful for γ spectrometry were carried out. It was elucidated from the studies that long-life nuclides practically usable for γ spectrometry exist in almost every element. Application of activation analysis can be extended by combining short-life and long-life nuclides. Selecting petroleum group hydrocarbons as samples, development of rapid analysis method for elements constituting organic substances, such as O, S, N, and H, was investigated. Also recoiling particle effect as the reaction of obstructing analysis was examined. The $^{16}O(n,p)^{16}N$ reaction was utilized for the analysis of O; the $^{34}S(n,p)^{34}P$ reaction for the analysis of S, $^{14}N(n,2n)^{13}N$ reaction for the analysis of N, and recoiling particle effect was utilized for the analysis of H. Data processing technique for radiation measurement with electronic computers and automation of the activation analysis were studied, and ACTEQ method was developed. This is the method of simulating radioactivity with electronic computers. Hitherto, instability of neutron output has caused trouble in the activation analysis with the Cockcroft-Walton type 14-MeV neutron generator, but adoption of the ACTEQ method enabled automatic quantitative determination of each element. (JA)

2491 DETERMINATION OF SOME ELEMENTS IN OIL ADDITIVES BY 14 MeV NEUTRON ACTIVATION ANALYSIS. Vandlik, T.; Kliment, V.; Scasnar, V. (Slovenska Akademie Vied, Bratislava). Radioisotopy; 14: No. 3, 537-545(1973). (In Slovak).

A method for the determination of oxygen, phosphorus, and barium in oil additives was developed. A neutron generator of original construction with a yield of 5.10^9n/s was used for the activation. The measured gamma spectrum was detected with 100 × 100 mm NaI(Tl) scintillation detector and registed with a 400-channel analyzer. The following nuclear reactions were used for the determination: $^{16}O(n,p)^{16}N$; $^{31}P(n,\alpha)^{28}Al$; $^{137}Ba(n,n')^{137m}Ba$, $^{138}Ba(n,2n)^{137m}Ba$. The determination reproducibility and dependence of the induced activity on the quantity of the determined element were investigated and comparisons with other analytical methods were made. (auth)

2492 NEUTRON ACTIVATION ANALYSIS IN THE WELDING RESEARCH INSTITUTE. Zitnansky, B. (Vyskumny Ustav Zvaracsky, Bratislava). Radioisotopy; 14: No. 3, 525-536(1973). (In Slovak).

The work of the activation analysis laboratory Kral-B in the Welding Research Institute in Bratislava is discussed. Some results are given of the neutron generator activation analysis (AANG), namely of the determination of Fe, O, Mg, and Mn in welding clinkers and fluxes. A method is described for the determination of Ge in Fe-based alloys, in which a semiconductor Ge(Li) detector was successfully used. Results are also presented for nitrogen determinations in organic materials, as e.g., arachnofaune, etc. (auth)

2493 NEUTRON-INDUCED ACTIVITY IN BIOLOGICAL SYSTEMS AND ITS APPLICATIONS IN DOSIMETRY. Prouza, Z.; Rakovic, M.; Hermanska, J. Radioisotopy; 14: No. 5, 827-869(1973). (In Czech).

Information is reviewed about the present state of applying the method of measuring the activity in a neutron-irradiated object for dosimetric purposes. A majority of works deals with measuring the ^{24}Na activity in the whole organism or, possibly, in body fluids (the blood, blood plasma or urine). The method is used for the dosimetry of neutrons with energies from those corresponding to thermal neutrons to 3.5 MeV. In this energy region the induced ^{24}Na activity is assumed to be directly proportional to the probability of the neutron capture in the object of interest. For fast neutrons (with energies above 2.5 MeV) the reaction $^{32}S(n,p)^{32}P$ is employed in many dosimetric systems. Possibilities of using the method, its limitations, examples and experimental results of various authors are discussed. (auth)

2494 NICKEL DETERMINATION IN ATMOSPHERIC POLLUTANTS. Das, H. A. (Stichting Reactor Centrum Nederland, Petten). pp 65-72 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Activation analysis is used for the systematic determination of elements in atmospheric pollutants collected on filter paper. About 150 mg of pollutant was obtained from 1500 m^3 of air pumped across a 22 × 13 cm^2 microsorban surface. The Ni determination process is divided into four phases: combustion, extraction, ion exchange, and counting. The sensitivity of the analysis is 2.10^{-2} g [i.e., 0.005 g/m^3 for a minimum quantity (1000 m^3) of air]. (FR)

2495 NEUTRON ACTIVATION ANALYSIS IN VIVO. Rakovic, M.; Prouza, Z. Radioisotopy; 14: No. 5, 801-825(1973). (In Czech).

Information is presented concerning the present state of developing neutron activation analysis in-vivo. This method is aimed at determining elements based on the in-vivo neutron activation and measurement of the induced activity. Certain regions may be activated with subsequent measuring of an organ of interest. This approach was used for determining iodine in the thyroid gland using the radionuclide ^{128}I. More typically, the activation in-vivo is used for determining the whole-body content of certain elements. Methods for determining sodium and calcium through measuring ^{24}Na and ^{49}Ca, are of the most importance. Thus, neutron activation analysis offers new possibilities of keeping the radiation hazard below the level encountered during common roentgenological or nuclear examinations. (auth)

2496 DETERMINATION OF CARBON, NITROGEN, OXYGEN, AND FLUORINE USING HIGH-ENERGY γ-PHOTON ACTIVATION AND RADIOCHEMICAL SEPARATION. Hislop, J. S. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Soc. Anal. Chem.; 11: No. 3, 61-63(Mar 1974).

It is stated that high-energy gamma-photon activation, unlike thermal neutron activation, permits the determination of the light elements, carbon, nitrogen, oxygen, and fluorine with high sensitivity. Analysis involves the measurement of short-lived pure β^+ emitters, and for optimum sensitivity and specificity use has to be made of radiochemical separations. Details are given of the application of the method to the determination of each element. Sensitivity and interferences are discussed. (UK)

2497 INSTRUMENTAL ACTIVATION ANALYSIS OF ALBUMINS AND NUCLEIC ACIDS. Andronikachvili, E. L.; Mosulichvili, L. M.; Belokobyskii, A. E. (Commission on Atomic Energy, Moscow). J. Radioanal. Chem.; 19: No. 2, 299-307(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

An instrumental activation method for the analysis of biological macromolecules of DNA, RNA, and albumins is reported. The technique was developed in order to establish differences in the contents of various elements in these macromolecules extracted from healthy and cancerous organs of experimental animals. (tr-auth)

2498 PRECISE NONDESTRUCTIVE ROUTINE ANALYSIS OF SMALL QUANTITIES OF ELEMENTS PRESENT IN SOLIDS USING REACTOR NEUTRON ACTIVATION. Bussiere, P.; Laurent, A. (CNRS, Villeurbanne, France). J. Radioanal. Chem.; 19: No. 1, 185-191(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Experiences gained in the routine nondestructive determination on the determination of minimum quantities of various elements present in quantity between 0.05 and 20 g with a relative precision of 1 to several percent were reported. The principal sources of error, primarily the neutron flux gradients due to the reactor or to self-absorption, were discussed. (tr-auth)

2499 RESULTS OBTAINED IN SLOVAKIA IN THE DETERMINATION OF TRACE ELEMENTS BY NEUTRON ACTIVATION ANALYSIS. Toelgyessy, J. (Slovak Technical Univ., Bratislava); Adamek, A.; Kliment, V.; Severa, F.; Sacha, J. J. Radioanal. Chem.; 19: No. 1, 169-175(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Some results obtained in research on neutron activation trace determinations at the Slovak Technical University and the Institute of Physics in Bratislava are presented. Neutron activation was done with a reactor and a fast neutron generator. (tr-auth)

2500 PROBLEMS IN THE ELEMENTARY ANALYSIS OF STANDARD BIOLOGICAL MATERIALS. Bowmen, H. J. M. (Univ. of Reading, Eng.). J. Radioanal. Chem.; 19: No. 2, 215-226(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Standard biological materials for elementary analysis are few and pose problems of homogeneity, reproducible conditions, drying, and storage. Their use has created a certain number of problems on the reliability of some analytical techniques and some of these do not always have a solution. These are illustrated by reference to a standard sample of kale, human blood, erythrocytes, and serum which were analyzed repeatedly. Reasonably sure values are now known for the following 35 elements in the standard sample of kale: Al, As, Au, B, Ba, Br, Ca, Cd, Cl, Co, Cr, Cs, Cu, F, Fe, Hg, K, La, Mn, Mo, N, Na, P, Pb, Rb, S, Sb, Sc, Si, Sn, U, V, W, and Zn; there are still uncertainties for Ag, Ce, Ga, I, Ir, Ni, Se, Sm, and Tl. In the blood the analysis of the following 17 elements are sufficiently exact to permit the use of this product as an approximate standard: Ba, Br, Ca, Cl, Cu, Fe, I, K, Mg, Na, Ni, P, Pb, Rb, Se, and Zn. However, there are serious doubts on the subject of the concentration constant of some of these elements. As a result of a recent study the exactitude of the results on Ag, As, Co, Cr, F, Hg, and Sb is also in doubt. (tr-auth)

2501 DETERMINATION OF TRACES IN SEMICONDUCTORS BY NEUTRON ACTIVATION. Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 19: No. 1, 7-22(1974). (In French).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The determination of traces in Ge, Si, and Se is described. By application of γ spectrometric techniques, preceded if necessary by chemical separations, it is possible to determine the following elements (1) in Ge: As, Cu, Au, Ga, Zn, Hg, Cr, Sn, Sb, Co, In, Ni, Ir, Se, Sc, Ag, Ta, Hf, and U; (2) in Si: P, Au, Sb, Ga, Fe, K, Cr, Mo, Sn, As, Co, In, Zn, Cu, W, Ta, Na, Eu, Sm, La, Sc, and Tl; and (3) in Se: Cl, Br, I, P, S, Te, Na, K, Cr, Fe, Co, Cu, Zn, Ga, Sc, Ag, Cd, La, W, Au, and Tl. The concentration on detection limits vary from several ppM to 10^{-3} ppB. (tr-auth)

2502 ^{3}He ACTIVATION ANALYSIS FOR S, Cl, K, AND Ca. Lee, D. M.; Markowitz, S. S. (Univ. of California, Berkeley). J. Radioanal. Chem.; 19: No. 1, 159-167(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Three easily detected radioisotopes ^{38}Cl, ^{34m}Cl, and ^{38}K, produced from S, Cl, K, and Ca, were used to detect these elements by ^{3}He activation. A number of samples were analyzed nondestructively using different nuclear reactions to examine the precision of the method and the extent of interferences. The absolute excitation functions for nuclear reactions with ^{3}He were given. (tr-auth)

2503 APPLICATION OF CHARGED PARTICLE ACTIVATION ANALYSIS TO THE TRACE CHARACTERIZATION OF SEMICONDUCTOR MATERIALS. Schweikert, E. A.; McGinley, J. R.; Francis, G.; Swindle, D. L.; McGinley, J. R.; Francis, G.; Swindle, D. L. (Texas A and M Univ., College Station). J. Radioanal. Chem.; 19: No. 1, 89-108(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

The application of charged particle activation analysis with measurement after irradiation to the detection of traces of O, B, and Li is described. Proton, alpha, and ^{3}He activation is used for the nondestructive determination of O in Si. The experimental detection limit is 0.06 ppM, 0.05 ppM, and 5 ppB respectively. ^{3}He activation, coupled with a radiochemical separation after irradiation, is used for the detection of O in Ge with a detection limit of 10 ppB. New techniques were developed for the determination of B and Li, based on the measurement of ^{8}Li ($T_{\frac{1}{2}}$ = 850 msec) and of ^{12}B ($T_{\frac{1}{2}}$ = 20 msec), and using a β measurement technique in coincidence with two thin plastic scintillators. The possibilities of the quasi-prompt methods are illustrated with results on Si, Ge, and glass samples. (tr-auth)

2504 DETERMINATION OF ELEMENTS IN MATERIALS BY MEANS OF THE REACTION (n,α). Kvitek, J.; Dlouhy, Z. (Czechoslovak Academy of Sciences, Prague). Radioisotopy; 14: No. 3, 481-489(1973). (In Czech).

The reactor VVR-S was used as a source of thermal neutrons for the purpose of activation analysis utilizing the (n,α) reaction. The experimental studies were carried out on very thin layers of different materials for the elements B, Li, ^{149}Sm, and ^{143}Nd. The use of the (n,α) reaction for boron analysis is suggested. (auth)

2505 APPLICATION OF SUBSTOICHIOMETRY TO RADIOACTIVATION ANALYSIS. Determination of Trace Impurities in High-Purity Materials. Kudo, K. (Nippon Telegraph and Telephone Public Corp., Tokai, Japan); Suzuki, N. J. Radioanal. Chem.; 19: No. 1, 55-63(1974).

From international colloquium on activation analysis of very low amounts of elements; Saclay, France (2 Oct 1972).

Since a new method of activation analysis has been proposed, a certain number of techniques have been developed for the determination of elements in trace amounts. The new technique is divided into the direct method, the method of carrier amount variation, and the comparison method. These methods have the following advantages: the correction of the chemical yield is not necessary, the secondary nuclear reactions and self-absorption do not constitute causes of error in the determination. The principle of these methods and the determination of very low concentrations in high-purity materials by the method of carrier amount variation and the comparison method are described. (tr-auth)

2506 UTILIZATION OF THE DECAY OF THE ISOMERIC STATE OF ^{199m}Hg FOR A RAPID DETERMINATION OF MERCURY BY INSTRUMENTAL ACTIVATION ANALYSIS. Duda, J. (Geologicky Pruzkum, Ostrava, Czech.). Radioisotopy; 14: No. 4, 693-713(1973). (In Czech).

For the excitation of the isomeric state of ^{199m}Hg ($T_{\frac{1}{2}}$ = 43 min) the interactions (n,n') and (n,2n) of fast neutrons (E_n = 14 MeV) from a neutron generator NG-200 with the target nuclei of stable isotopes ^{199}Hg and ^{200}Hg, occurring at their short time irradiation with fluxes of 2.6×10^{8} n/cm^{2} · s, were employed. A spectrometric apparatus with a Ge(Li) detector with an effective volume of 40 cm^{3} and a resolution power of 3.6 MeV (^{60}Co) were used for the detection of the gamma quanta emitted in the ^{199m}Hg decay. The determination of the mercury content in samples was performed by comparison with standards using the photopeak areas of 72-keV Hg (K α_1 K α_2) or of 158- or 374-keV ^{199m}Hg gamma spectra, processed manually or with a small computer TPA ("on-line" operating mode). Simultaneously with mercury, a number of other elements may be determined, which yield at short time irradiation radioisotopes with a short $T_{\frac{1}{2}}$ and photopeaks in the soft region of the gamma spectrum, where the Ge(Li) detector shows the maximum of absolute efficiency. The effect of a six-fold prolongation of the irradiation time on the determination sensitivity in samples containing Hg and halogens is exemplified on regimes of 300-15-300 and 1800-15-300 seconds. The described method is suitable for a rapid non-destructive determination of Hg and other elements in binary and elementalorganic compounds with one or more metallic heteroelements in mixture, alloys, amalgams and other technical products. (auth)

2507 STUDY OF ANALYTICAL POSSIBILITIES OF URANIUM DETERMINATION USING DELAYED NEUTRONS INDUCED BY 14 MeV FAST NEUTRONS. Mayer, J. (Vyzkumny Ustav Hutnictvi,

Zeleza, Dobra, Czech); Vobecky, M. Radioisotopy; 14: No. 4, 681-692(1973). (In Czech).

The applicability of a neutron generator to the nondestructive determination of uranium in ores, concentrates and their intermediate processing products by detection of delayed neutrons induced by fast neutron fission of the analyzed element was verified. The samples were irradiated with 14-MeV neutrons from the generator Na-2 (KFKI Budapest). The delayed neutrons were detected, after moderation in a paraffin block, with six counters filled with BF_3, enriched with ^{10}B (SNMO-5, USSR). Under conditions of 60-sec activation, 20-sec decay, 1 and 2 min counting resp., at a neutron flux 4.10^7 n · cm^{-2} · s^{-1}, uranium was detected with a sensitivity of 2.1×10^3 counts/g · min and 2.6×10^3 counts/g · 2 min, respectively, and for thorium these values are 1.2 counts/g · min. and 1.5×10^3 counts/g · 2 min. respectively (background 1.1 cpm). Under the employed experimental conditions, samples containing 10 to 400 mg of uranium may be analyzed, which is confirmed by the good agreement of the found uranium contents with the values obtained by chemical method of analysis. (auth)

2508 TIME SELECTION IN ACTIVATION ANALYSIS. Vozzhenikov, G. S. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 143-144(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 113-114(Feb 1973). This is a summary of paper No. 648/6768 with full copy held by TIC.

Activation of materials of complex chemical composition usually results in the formation of several artificially radioactive products including some that hinder quantitative analysis of tracer isotopes. Conditions favoring noise discrimination with the aid of time selection, which plays a role in nondestructive activation analysis similar to that played in deactivation, in combined research efforts, are formulated. (auth)

2509 USE OF MULTI-ELEMENT STANDARDS IN INSTRUMENTAL ACTIVATION ANALYSIS. Vobecky, M. (Inst. of Experimental Mineralogy and Geology, Prague); Benada, J. Radioisotopy; 14: No. 4, 623-633(1973). (In Czech).

Multi-element standards (MES) have found a wide use in instrumental activation analysis, namely in its routine applications. The advantages of MES and the main criteria, important for their preparation are considered. The individual combinations, composed on the basis of long experience, are given for different matrix types. The rightness and precision of determination by means of MES is demonstrated on the analysis of a number of elements in lunar materials. (auth)

2510 RAPID DETERMINATION BY INSTRUMENTAL ACTIVATION ANALYSIS OF GERMANIUM AND SOME HALOGENS BY MEANS OF NEUTRON GENERATOR AND GAMMA SPECTROMETRY WITH A SEMICONDUCTOR Ge(Li) DETECTOR. Duda, J. (Geologicky Pruzkum, Ostrava, Czech.). Radioisotopy; 14: No. 4, 561-584(1973). (In Czech).

The paper is a continuation of a study on the possibilities of rapid determination of Ge, F, Cl, Br and I, alone or in combinations, which was started with a NaI(Tl) scintillation detector. The developed methods are suitable for the determination of the mentioned elements in binary and elemental-organic compounds, as well as in a number of technical products containing these elements as macrocomponents, where the analysis by classical methods of organic analysis involving the mineralization of the sample with final photocolorimetric measurement is time consuming. (LK)

2511 DETERMINATION OF SOME LANTHANIDES BY THE MEASUREMENT OF PROMPT GAMMA INDUCED BY NEUTRONS. Vobeck, M. (Inst. of Experimental Mineralogy and Geology, Prague); Konecny, K. Radioisotopy; 14: No. 4, 547-560(1973). (In Czech).

The possibilities of analytical applications of a method based on the measurement of prompt gamma radiation were investigated. With regard to quantitative analytical applications, the influence of elements with extreme cross-section values for thermal neutron absorption on the neutron flux attenuation by the sample was studied. The conclusions of methodical experiments are illustrated on a practical example of the determination of gadolinium and samarium content in apatite. (auth)

2512 USE OF INSTRUMENTAL ACTIVATION ANALYSIS FOR THE DETERMINATION OF LOSSES OF RARE EARTH ELEMENTS USED AS ADDITIVES IN TRIAL STEEL HEATS. Burianova, M. (Statni Vyzkumny Ustav Materialu, Prague); Frana, J. Radioisotopy; 14: No. 4, 635-648(1973). (In Czech).

IAA was used for the determination of trace amounts of some rare-earth elements which were added in the form of misch metal to trial steel heats to improve their mechanical properties. Samples of steel CSN 422714 with an admixture of 0.12 to 0.15% misch metal were activated in the nuclear reactor of the Nuclear Research Institute, Rez. The spectra of the irradiated samples were measured with a semiconductor Ge(Li) detector using a 400-channel analyzer with a biased amplifier. The melts were analyzed for the final content of cerium and lanthanum in concentrations of 10 to 10^2 ppM. The spectra were computer processed in cooperation with the Nuclear Spectroscopy Department of the Institute of Nuclear Physics, Czechoslovak Academy of Science in Rez. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 2718, 2719, and 3688.

2513 (AECL-4666) SENSITIVE DETERMINATION OF CHLORINE IN LIQUID HYDROCARBONS AS APPLIED TO POLYPHENYLS. Smith, G. G.; Stewart, R. B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1974. 29p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

A method for the analysis of chlorine in liquid hydrocarbons is described. It was developed for polyphenyl-based nuclear reactor coolants and has been successfully used for this application for several years. The method is based upon combustion of a sample in an oxy-hydrogen flame, condensation of the water and hydrochloric acid produced and determination of the chloride by precision null-point automatic titrimetry using specific ion electrodes. The sensitivity of the method is 20 μg/kg, without preconcentration techniques. (auth)

2514 (AECL-4772) ANALYSIS FOR GADOLINIUM IN HEAVY WATER BY FLAME EMISSION. Hurtesu, M.; Mislan, J. P.; Ashley, R. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1974. 17p. Dep. NTIS (U. S. Sales Only) $4.00. AECL $0.50.

Methods are described for the determination of gadolinium in water by flame emission techniques. High concentrations (50 to 10,000 μg/ml) are determined by direct aspiration into the flame. Medium concentrations (1 to 50 μg/ml) can be determined after concentration by evaporation or with signal enhancement by addition of perchloric acid. For concentrations <1 μg/ml, solvent extraction with 1-(2-pyridylazo)-2-naphthol (PAN) is used for preconcentration. Interference from boron can be suppressed by addition of NH_4Cl. (auth)

2515 (CEA-CONF-2559) ANALYTICAL METHODS FOR THE STUDY OF WATER POLLUTION. Baudin, G.; Darras, R.; Roth, E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 15 Jun 1973. 18p. (In French). (CONF-731060-2). Dep. NTIS (US Sales Only) $4.00.

From meeting of anti-pollution techniques; Grenoble, France (2 Oct 1973).

The possibilities and the orientation in determination of water pollution are illustrated by examples and a suggested analytical scheme. In the analysis of water the detection limits to be attained and the complexity of the medium determine the analytical methods used. Three methods are described for the concentration of water: evaporation, solvent extraction, and ion exchange on resins. Four highly sensitive which do not require concentration are described. These are fluorimetry for the determination of cyanides and nitrites, atomic absorption, spectrography, and neutron activation. The special case of sea water is considered. The determinations of the total C and of adenosine triphosphate are discussed as examples of the determination of organic compounds. For the identification of organic compounds the association of gaseous chromatography and mass spectrometry is recommended. (JSR)

2516 (CENA-BT-2) SAMPLE PREPARATION FOR ^{15}N ANALYSIS BY MASS SPECTROMETRY. Trivelin, P. C. O.; Salati, E.; Matsui, E. (Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil)). Jul 1973. 41p. INIS.

Sample preparation techniques by mass spectrometry are reviewed. Special attention is given to the ^{15}N and its isotopic analysis is presented with an accuracy over 1%. The $^{15}N/^{14}N$ isotope ratio gets over 0.2%. Methods and measurements are described. (INIS)

2517 (CONF-740429-1) EXPERIMENTAL EVALUATION OF A SIMPLE MODEL FOR QUANTITATIVE ANALYSIS IN X-RAY PHOTOELECTRON SPECTROSCOPY. Carter, W. J.; Schweitzer, G. K.; Carlson, T. A. (Syracuse Univ., N. Y. (USA); Oak Ridge National Lab., Tenn. (USA)). [nd]. 9p. Dep. NTIS $4.00.

From international conference on progress in research and applications of electron spectroscopy; Namur, Belgium (16 Apr 1974).

A simple model is described for calculating the relative intensities of photoelectron peaks for the different elements in a homogeneous solid sample. Using photoelectron cross sections of Scofield for Al and Mg Kα x rays, we have determined the relative intensities of photoelectron peaks for various core subshells of all the elements from Z = 3 to 92. The calculated values are compared with experimental values for both gases and solids, and agreement is found to be satisfactory. Some of the special problems in quantitative analysis using x-ray photoelectron spectroscopy are discussed. In particular, it is shown how information regarding surface inhomogeneity may be obtained from comparison of intensities of photoelectron peaks. (auth)

2518 (EPA-680-4-73-2) SIMPLIFIED ATOMIC ABSORPTION DETERMINATION OF STABLE STRONTIUM IN MILK AND HAY: A COMPARISON OF METHODS AND STEPWISE PROCEDURE. Barth, J.; Bruckner, B. H. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 32p. GPO $0.70.

A highly simplified atomic absorption procedure for the determination of stable strontium in fluid milk, milk powder, and alfalfa is evaluated. A comparison is made between the atomic absorption method of additions and the standard curve method. A suggested step-wise procedure is given.

2519 (JAERI-M-5426) SPECTROPHOTOMETRIC STUDY OF THE REACTION BETWEEN THORIUM AND CHLOROPHOSPHONAZO-III. Yamamoto, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 17p. (In Japanese). NTIS (US Sales Only).

Thorium forms a colored complex with Chlorophosphonazo III in 1M hydrochloric acid. The molar absorption coefficient of the complex is 4.6×10^4 ($l\ mol^{-1}\ cm^{-1}$) at 690 nm. When the complex is extracted with 3-methyl-1-butanol, the absorption peak shifts to the shorter wavelength and the molar absorption coefficient in the organic phase becomes 13×10^4 at 690 nm. The composition of the thorium–Chlorophosphonazo III complexes in both aqueous and organic phases was estimated by mole ratio method, slope ratio method, and continuous variation method. The purity of the reagent used was estimated as 60%. The ratio of metal to the reagent is likely to be 1:1 in 1 M hydrochloric acid and 1:2 in 3-methyl-1-butanol. The structure of the complexes is probably similar to that proposed for the Arsenazo III complexes by Savvin. Thorium combines with one of the two symmetrical functional groups of the reagent. Azo, phosphonic, and phonol groups coordinate the central metal ion and form stable six-membered rings. (auth)

2520 (Y-1940) STUDY OF FACTORS AFFECTING CALIBRATIONS AND CALCULATIONS FOR THE MONOCHROMATIC X-RAY ABSORPTION-EDGE ANALYTICAL METHOD. Barringer, R. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 17 May 1974. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

A modified calculation equation gave results more closely following the known values of standard samples. Recommendations are given for improving the choice of standards and calibration procedure for the monochromatic x-ray absorption method. (auth)

2521 MATRIX EFFECTS IN THE EMISSION SPECTROMETRIC ANALYSIS OF TRACE METALS IN BIOLOGICAL SPECIMENS. Niedermeier, W.; Griggs, J.H.; Webb, J. (The Division of Clinical Immunology and Rheumatology, Department of Medicine, The University of Alabama, Birmingham, Alabama 35294). Appl. Spectrosc. 28: No. 1, 1-4 (Jan 1974).

A study was made of the effect of metals that appear in animal tissues in the mg% range on the spectrochemical determination of certain trace metals in a NaCl matrix. The presence of as little as 1 mg% of iron, magnesium, calcium, potassium, or phosphorus had a marked influence on the spectral response of the trace metals (Cu, Fe, Al, Ba, Mn, Ni, Ca, Sn, Sr, Cr, Zn, Pb, Mo, and Cd) studied. Matrix effects in this medium did not appear to be concentration-dependent or additive. It was concluded that unless the matrix compositions of standard and specimen were closely matched, serious analytical errors would result. (auth)

2522 SPECTROGRAPHIC DETERMINATION OF TRACE ELEMENTS IN FERROUS MATERIALS. Morello, B.; De Gregorio, P.; Savastano, G. (Centro Sperimentale Metallurgico S.p.A., Casella Postale 10747 EUR, Rome, Italy). Appl. Spectrosc. 28: No. 1, 14-23 (Jan 1974).

A method is described for the spectrographic determination of trace elements in ferrous materials. The powdered sample is first mixed with PTFE (polytetrafluoroethylene) and graphite in the ratio 100:10:25. This mixture is then submitted to direct excitation in a 10 A dc arc, utilizing a capped supporting electrode of the Scribner-Mullin type, with reverse polarity (sample: negative; counter electrode: positive), the spectrum being taken from the central-cathodic region of the arc. The method may be used to determine Al, As, B, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Sb, Sn, Ti, V, Zn, and Zr. The detection limits are indicated, as are data on the precision and accuracy obtainable. (auth)

2523 CONCENTRATION OF SUBSTANCES IN POLAROGRAPHIC ANALYSIS. XV. Determination of Cerium as Cerium Phytate. Brainina, Kh. Z.; Fedorova, N. D.; Fokina, L. S. (Inst. of National Economy, Sverdlovsk, USSR). Zh. Anal. Khim.; 29: No. 2, 254-258(Feb 1974). (In Russian).

The effect of the supporting electrolyte composition, cerium(III) concentration, and electrolysis potential and duration on the character of polarization curves of electrochemical reducing cerium phytate formed in the anodic cycle has been studied. A method is suggested for electrochemical concentration of cerium(III) as cerium(IV) phytate on the surface of a graphite electrode and determination of Ce with the sensitivity of 0.01 μg/μl. (auth)

2524 REACTION OF ZIRCONIUM WITH REAGENT BPAS AND ITS ANALYTICAL USE. Basargin, N. N.; Davydova, R. T. (Inst. of Geology of Ore Deposits, Petrography, Mineralogy, and Geochemistry, Moscow). Zh. Anal. Khim.; 29: No. 2, 275-278 (Feb 1974). (In Russian).

Interaction of zirconium with sodium 2-bromo-4.5-dioxyazobenzene-4-sulfonate (BPAS) in 0.6–1 M HCl has been studied and the formation of 1:1 complex with $\lambda_{max} = 520$ (molar extinction coefficient $2 \cdot 10^4$). The ion $Zr(OH)_3^+$ takes part in complex formation with quinonhydrozone form of the reagent BPAS. The data obtained are used for the development of spectrophotometric determination of zirconium in magnetic alloys. (auth)

2525 INFLUENCE OF ADDITION OF METAL CHLORIDE DURING SPECTRAL DETERMINATION OF TUNGSTEN AND MOLYBDENUM ON SILICA. Shuvalova, E. I.; Khlystova, A. D.; Tarasevich, N. I.; Gongalyuk, N. G. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 2, 384-386(Feb 1974). (In Russian).

Influence of CsCl, KCl, NaCl, $BaCl_2$, $ZnCl_2$, $AlCl_3$, $SnCl_2$, $PbCl_2$, AgCl, $CuCl_2$, CuCl, $CdCl_2$ on the intensity of Mo and W spectral lines in dc arc was investigated. CuCl was proved to be the most efficient addition. X-ray investigation of reaction products produced in electrode crater has been carried out. The influence of metal chloride on arc discharge temperature has been studied during spectral determination of microimpurities of Mo and W. The conditions of spectral determination of W and Mo on a silica basis with addition of CuCl (1:1) are chosen by Box-Wilson method. The sensitivity obtained is $5 \cdot 10^{-4}$% W and $5 \cdot 10^{-6}$% Mo. The relative standard deviation is 0.1 for determination of $1 \cdot 10^{-3}$% W and $1 \cdot 10^{-5}$% Mo. (auth)

2526 CATALYTIC EFFECT OF RUTHENIUM(III) IN A REACTION OF REDUCING FERRIC THIOCYANATE WITH THIOSULFATE. Vershinin, V. I.; Reznik, B. E.; Statsenko, V. P. (Sibirian Automobile-Road Inst., Omsk, USSR). Zh. Anal. Khim.; 29: No. 2, 380-381(Feb 1974). (In Russian).

A catalytic reaction for determination of ruthenium(III) microamounts is suggested. The reaction is based on the catalytic effect of Ru(III) in the reduction of ferric thiocyanate with thiosulfate. (auth)

2527 SEPARATION OF TELLURIUM AND GALLIUM BY EXTRACTION CHROMATOGRAPHY. Bokova, T. A.; Kuz'man, N. M. Zh. Anal. Khim.; 29: No. 2, 386-389(Feb 1974). (In Russian).

The conditions of extraction chromatographic separation of Ga and Te have been determined in the hydrochloric acid–n-decyl alcohol system. A luminescence determination of Te in epitaxial layers of gallium arsenide has been suggested. The detection limit is $5 \cdot 10^{-4}$% with a 20-mg sample. Variation coefficient is less than 20%. (auth)

2528 DETERMINATION OF URANIUM AFTER ITS SELECTIVE EXTRACTION AS PHENYLACETATE. Adam, J. (Charles Univ., Prague); Ptibil, R. Talanta; 20: No. 12, 1344-1347(Dec 1973).

The method described is based on the extraction of uranium with a chloroform solution of phenylacetic acid from slightly acidic solution containing nitriotriacetic acid, which masks all interfering metals. After stripping into very dilute hydrochloric acid, uranium is reduced with ascorbic acid and determined complexometrically. The method permits reliable determination of uranium in the presence of all quadri-, ter- and bivalent metals investigated, molybdenum(VI), tungsten(VI), and vanadium(V). (auth)

2529 SOLVENT EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTHS WITH CHLOROPHOSPHONAZO-III. Taketatsu, T.; Kaneko, M.; Kono, N. (Kyushu Univ., Fukuoka). Talanta; 21: No. 1, 87-91(Jan 1974).

The rare earth (La, Pr, Sm, Gd, Dy, Er, Lu) chlorophosphonazo III chelates are easily extracted from an aqueous solution (pH 1.1 to 1.5) into n-butanol. The absorbance at the absorption maximum (at 668 nm) is about 3 times that in aqueous solution. The spectrophotometric determination of rare earths was investigated. (auth)

2530 DETERMINATION OF THORIUM IN THE PRESENCE OF SOME BIVALENT METAL IONS. Pribil, R.; Vesely, V. (Polarograficky Ustav J. Heyrovskeho, Prague). Talanta; 20: No. 12, 109-111(Dec 1973).

A new method for complexometric determination of thorium in the presence of bivalent metals without their masking is presented. Two aliquots of metal solution are necessary. In one the sum of thorium and other metals is determined by DTPA titration. The second aliquot is treated with Zn_2TTHA complex. Only thorium, forming a 1:1 complex with TTHA, displaces twice its molar amount of zinc from the complex, while other elements displace only an equimolar amount of zinc. The amount of thorium corresponds to the difference of consumption in the two titrations. (auth)

2531 PROTON INDUCED X-RAY EMISSION AS A TOOL FOR TRACE ELEMENT ANALYSIS. Folkmann, F.; Gaarde, C.; Huus, T.; Kemp, K. (Univ. of Copenhagen). Nucl. Instrum. Methods; 116: No. 3, 487-499(1974).

For protons and heavier ions with energies in the MeV range we have studied the production of characteristic x rays from elements with $Z \geq 13$ using a semiconductor x-ray spectrometer. Various competing background processes have been identified. Theoretical estimates of the background radiation due to bremsstrahlung from secondary electrons and due to proton bremsstrahlung have been evaluated, and on the basis we have calculated lower limits for the sensitivity obtainable for the concentration of the trace element, ranging down to values of 10^{-6} to 10^{-7}. Different projectiles and incident energies have been compared, and it is shown that this method of x-ray production is about 3 orders of magnitude cleaner than can be obtained by electron bombardment. (auth)

2532 NONDESTRUCTIVE RAPID IDENTIFICATION OF METALS AND ALLOYS BY SPOT TEST. Philadelphia; American Society for Testing and Materials (1974). 57p. (ASTM-STP-550). $4.00.

A system of identification of metals and alloys employing chemical spot test techniques suitable for shop and laboratory use was developed. Conclusions relative to identification are derived from unique reactions or the colors produced by the addition of reagents. Tests are conducted on the metal's surface, in a spot plate depression, or on qualitative filter paper. All tests are qualitative; however, many of the tests can be employed semiquantitatively. The procedures cover aluminium and aluminium alloys, copper and copper alloys, magnesium and magnesium alloys, nickel and nickel alloys, stainless and heat resisting steels, carbon and low alloy steels, tool steels, titanium and titanium alloys, and some pure metals including Cd, In, Pb, Mo, Ag, Ta, Sn, W, V, and Zn. (DHM)

2533 PRESENT STATUS OF THE N-SILICON/STAINLESS STEEL COMBINATION ELECTRODE FOR ACID DETERMINATIONS. McKaveney, J. P. (Garrett Research and Development Co., Inc., La Verne, CA); Buck, M. D. Anal. Chem.; 46: No. 6, 650-654(May 1974).

The N-silicon/stainless steel combination electrode was examined more critically as both a general acid monitor and selective hydrofluoric acid (HF) analyzer. Metallic ions in their lowest stable oxidation state in an aqueous medium (Al^{3+}, Fe^{2+}, Ni^{2+}, Mn^{2+}, Pb^{2+}, and Zn^{2+}) appear to produce little or no interference in acid measurement. However, metallic ions in reducible oxidation states (Cr^{3+}, Cu^{2+}, Fe^{3+}, and UO_2^{2+}) produce readings about 5% high in acid value. The effect is not appreciably concentration-dependent and can be screened out by addition of the reducible ion to the NH_4F calibration electrolyte. Applications are given for the measurement of both free and hydrolysis acid (Sb^{3+}-rapid hydrolysis) as well as for free acid in the presence of cations (Cu^{2+} and Zn^{2+}) not hydrolyzing at low pH values. The electrode is also applied to the measurement of free HF in phosphoric acid (fertilizer industry) as well as to the type of fluoride complexes (Al^{3+}, Fe^{3+}, Si^{4+}) present in strong phosphoric acid produced from phosphate rock. (auth)

2534 SEPARATION OF TRACE AMOUNTS OF URANIUM AND THORIUM AND THEIR DETERMINATION BY MASS SPECTROMETRIC ISOTOPE DILUTION. Arden, J. W.; Gale, N. H. (Oxford Univ.). Anal. Chem.; 46: No. 6, 687-691(May 1974).

A rapid low blank method is described for the separation of uranium and thorium by reversed phase chromatography from a variety of matrices, especially complex natural silicates. The technique is especially suitable as a separation step, after prior removal of lead by electrodeposition, for subsequent uranium and thorium concentration determination by mass spectrometric isotope dilution. A single filament thermal ionization mass spectrometric technique for uranium is described which is suitable for the accurate measurement of nanogram quantities of uranium in meteorites and other samples. The use of this technique in conjunction with fast ion counting using a scintillation detector is illustrated by measurements of the National Bureau of Standards U-500 isotopic uranium standard. (auth)

2535 ENRICHMENT OF TRACES OF RARE EARTHS IN MINERAL WATERS BY MEANS OF ION-EXCHANGERS. Nevoral, V. (Vyzkumny Ustav Balneologicky, Marianske Lazne, Czech.). Z. Anal. Chem.; 268: No. 3, 189-193(Feb 1974). (In German).

In the analysis of mineral waters, after flow of the sample through a column with Dowex 50 WX12 in H^+ form, the main cations are first eluted by 1.6N HCl and then the rare earths by 6N HCl. The latter are separated by ion-exchange chromatography on Dowex 50 WX8 in NH_4 + form, the elution being performed with ammonium citrate at pH = 4.19. The presence of rare earths in the eluate was ascertained spectrophotometrically by means of their reaction with xylenol orange in the presence of cetylpyridinium bromide. In mineral waters from the West-Bohemian spa region, it was possible to find traces of trivalent La, Ce, Pr, Nd, Sm + Gd, Y, Dy, Ho, Er, Tm, Yb and Lu. (GE)

2536 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM WITH STILBAZO IN THE PRESENCE OF ZEPHIRAMINE AND ITS APPLICATION TO THE DETERMINATION OF MOLYBDENUM IN IRON AND STEEL. Ozawa, T. (Tokyo Metropolitan Industrial Tech. Center); Okutani, T.; Utsumi, S. Jap. Anal.; 22: No. 12, 1592-1597(Dec 1973). (In Japanese).

Molybdenum reacts with stilbazo in the presence of zephiramine to give a water-soluble red complex. Its absorption maximum is at 535 nm, and the absorbance shows a roughly constant value at pH 3.6 ~ 4.2, but the maximum absorbance has at pH 5.2, although the pH range for the constant absorbance was not obtained. Therefore, molybdenum is determined at 535 nm and pH 3.9. A liner calibration curve is obtained up to 32 μg of molybdenum in a 50 ml solution. The apparent molar absorptivity of this complex is found to be 6.35×10^4; The concentration of molybdenum corresponding to the absorbance ($\log I_0/I$) of 0.001 is 0.0015 μg/cm². L-Ascorbic acid solution was added in advance to remove the interference of iron(III). Aluminum, gallium, vanadium(IV, V), titanium, zirconium, tungsten, palladium, lead and perchlorate interfered seriously with the determination, but aluminum, vanadium and titanium of the same order of magnitude as molybdenum could be masked by the addition of ammonium fluoride, and the interfering zirconium was also masked with ammonium fluoride. However, tungsten was not masked with it. This reaction was applied to the determination of molybdenum in iron and steel. Analytical results of the standard samples of iron and steel by this method were satisfactory, and furthermore this method could be applied to all except the steel sample containing tungsten. (auth)

2537 QUANTITATIVE SPECTROGRAPHIC ANALYSIS OF CASSITERITE. Sal'manova, V. A. Tr. Vses. Nauch.-Issled. Inst. Zolota Redk. Metal.; No. 29, 409-420(1969). (In Russian).

Procedures are described for determining 0.03 to 1% of Nb, 0.05 to 2% of Ta, 0.001 to 0.5% of Y, 0.01 to 0.5% of La, 0.003 to 0.1% of Sc, 0.0005 to 0.1% of Ga and 0.01 to 0.1% of In with errors ranging from 4 to 10%; and for determining SiO_2, Al_2O_3, Fe_2O_3, TiO_2, MnO, CaO and MgO with errors ranging from 6 to 10%. (Referativnyi Zh.)

2538 ISOTOPE RATIO MEASUREMENT BY MASS SPECTROMETRY. Ogata, K. (Osaka Univ., Toyonaka, Japan). Kagaku No Ryoiki; 27: No. 5, 383-392(May 1973). (In Japanese).

Description is made on the historical development of mass spectrometry systematic error found in isotope ratio measurement, and background in the determination of the ratio. Idea of the isotope ratio was developed by Wien, J. J. Thomson, Soddy, and Aston, from 1898 to 1919. By 1924, most of the isotopes of all elements were found, and the isotope ratio was determined. Contribution by Dempster in the improvement of the mass spectrograph resulted in the accurate determination of the ratio. Discovery by Toshizo Chitani on the indefinite isotope ratio of oxygen and hydrogen in rain water led to the destruction of the well-established concept that natural isotope ratio is definite. Now it is accepted that the isotope ratio is not necessarily definite in natural materials. The ratio of detected amount of isotope to the amount of the isotope in sample is called discrimination. Discussion is made on the mass discrimination in the gas introduction

system, in sputtering ion source, and relation between the discrimination and relative amount of sample to be analyzed. For the determination of the ionic amount, Faraday cage is simplest and is most reliable. The use of secondary electron multiplying system brings about some complex problems, which require accurate calibration. (JA)

2539 IN-LINE DISTILLATION UNITS AND SAMPLING DEVICE FOR THE ANALYSIS OF LIQUID SODIUM FOR A LOOP SYSTEM. Bos, L. (Metaalinstituut TNO, Apeldoorn, Netherlands). pp 53-58 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From International conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Two types of in-line distillation units were tested. In the first case the sampling crucibles are located in an argon atmosphere during flushing with sodium (ILDA-gas system). In the second case the crucibles are located in full flow sodium (ILDA-NA system). The construction and handling of both types are described. Both of these methods give results equal to those obtained by the laboratory distillation method. The ILDA-Na device appears, however, to have considerable advantages over the ILDA-gas. A scheme for the eventual application of ILDA-Na in radioactive sodium is given. Also, a simple sampling device for sodium is described. (auth)

2540 MONITORING OF HYDROGEN AND OXYGEN IN LIQUID SODIUM. Smith, C. A. (Central Electricity Generating Board, Berkeley, Eng.). pp 101-106 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Hydride-activated hydrogen concentration cells, of the type: H_2 (p_1/Fe/MH/Fe/H_2 (p_2)), are described where the iron is in the form of thin hydrogen permeable membranes. Electrolytes consisting of calcium hydride-calcium chloride mixtures have been found to give close to theoretical emfs and have been used to measure the equilibrium hydrogen dissociation pressure of lithium-lithium hydride between 550 and 380°C. The emf response following a stepwise change in hydrogen pressure is compared with two simple diffusion models. Preliminary experiments to evaluate commercially available $ThO_2-Y_2O_3$ electrolytes for the measurement of oxygen in sodium are also described. (auth)

2541 PROGRESS IN THE DEVELOPMENT OF A CARBON METER FOR SODIUM-COOLED FAST REACTORS. Asher, R. C.; Bradshaw, L.; Kirstein, T. B. A.; Nixon, T. H.; Tolchard, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). pp 133-135 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The carbon meter described (covering carburizing potentials of 10^{-4} upwards) involves diffusion of carbon through an iron membrane and its conversion to carbon monoxide by reaction with an iron oxide film. A Flame Ionization Detector is used to determine the carbon monoxide production rate. Tests of the meter, out-of-reactor, are in progress and the in-reactor meter is under construction. (auth)

2542 SPECTROGRAPHIC DETERMINATION OF TRACES OF COPPER, LEAD, CHROMIUM, NICKEL, MOLYBDENUM, AND COBALT IN NATURAL WATERS. Sahini, V. E.; Craiu, M.; Ivana, E. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 19: No. 2, 165-167(Feb 1974).

The traces of copper, lead, chromium, nickel, molybdenum and cobalt were determined spectrographically by the carrier distillation method in natural waters. Sodium chloride, cesium chloride and a mixture of sodium chloride and silver fluoride were utilized as carriers. (auth)

2543 NUCLEAR MAGNETIC RESONANCE SPECTROMETRY. Wasson, J. R.; Johnson, D. K. (Univ. of Kentucky, Lexington). Anal. Chem.; 46: No. 5, 314R-345R(Apr 1974).

This review covers the published literature from July 1971 to July 1973. The following topics are considered: chemical shifts; spin-spin coupling constants; multiple resonance, spin echoes, CIDNP, and pulsed resonance and Fourier transform methods; relaxation; nuclear Overhauser effect; liquid crystals; solid state; computer applications; line shapes and broadening; chemical exchange; NMR shift reagents; hydrogen bonding, self-association, ion pairs, electrolyte solutions and solvent effects; biochemical systems; general organic; conformational analysis, tautomerism, and rotational isomers; polymers; high-resolution NMR; general inorganic; deuterium; helium; alkali and alkaline metals; boron; aluminum-gallium-indium-thallium; ^{13}C; silicon, germanium, and tin; ^{14}N; ^{15}N; phosphorus; arsenic-antimony-selenium; sulfur; fluorine; chlorine, bromine, and iodine; iron; cobalt; platinum and palladium; copper, silver, and gold; lead, zinc, cadmium, and mercury; and paramagnetic complexes and compounds. (2218 references) (LK)

2544 THERMAL ANALYSIS. Murphy, C. B. (Xerox Corp., Rochester, NY). Anal. Chem.; 46: No. 5, 451R-459R (Apr 1974).

The review on thermal analysis covers differential thermal analysis-differential scanning colorimetry, thermogravimetric analysis, and other methods. (245 references) (LK)

2545 X-RAY DIFFRACTION. Pfluger, C. E. (Syracuse Univ., NY). Anal. Chem.; 46: No. 5, 469R-478R(Apr 1974).

This review covers the period of January 1972 through December 1973. Subjects discussed are: instrumentation; the powder method; quantitative analysis; geological applications; materials science; small-angle scattering; polymer applications; and single-crystal structure analysis. (405 references) (LK)

2546 FLUOROMETRIC ANALYSIS. Weissler, A. (Food and Drug Administration, Washington, DC). Anal. Chem.; 46: No. 5, 500R-521R(Apr 1974).

This review covers primarily the literature indexed by Chemical Abstracts during the period December 1971 to December 1973. Topics included are: instrumentation and techniques; inorganic; and organic and biological. (1028 references) (LK)

2547 ION EXCHANGE. Walton, H. F. (Univ. of Colorado, Boulder). Anal. Chem.; 46: No. 5, 398R-413R(Apr 1974).

Equilibrium kinetics, and exchanger properties; new exchangers; liquid ion exchangers; nonchromatographic applications; paper and thin-layer chromatography; columns and detectors; inorganic applications; and organic and biochemical applications are reviewed. Tables of inorganic ion exchangers, inorganic applications, and organic and biomedical applications are included. (565 references) (LK)

2548 ELECTRON MICROSCOPY. Beer, M. (Johns Hopkins Univ., Baltimore). Anal. Chem.; 46: No. 5, 428R-430R(Apr 1974).

The review on electron microscopy covers electron scattering, instruments, techniques relating to the specimen, and biological applications. (40 references) (LK)

2549 AMPEROMETRIC TITRATIONS. Stock, J. T. (Univ. of Connecticut, Storrs). Anal. Chem.; 46: No. 5, 1R-8R(Apr 1974).

Topics covered in this review are: apparatus and methodology, acid-base reactions, and precipitation and complexing reactions. The period covered by this review is from the previous one [Anal. Chem. 44(5), 1R(1972)] through October 1973. (314 references) (LK)

2550 ELECTROANALYSIS AND COULOMETRIC ANALYSIS. Davis, D. G. (Louisiana State Univ., New Orleans). Anal. Chem.; 46: No. 5, 21R-28R(Apr 1974).

Topics covered include: recent trends and some basic studies; electroseparations and electrogravimetry; controlled potential coulometry; controlled current coulometry-coulometric titrations; and apparatus. This review covers the period December 1971 to December 1973. (281 references) (LK)

2551 ION SELECTIVE ELECTRODES, POTENTIOMETRY, AND POTENTIOMETRIC TITRATIONS. Buck, R. P. (Univ. of North Carolina, Chapel Hill). Anal. Chem.; 46: No. 5, 28R-51R (Apr 1974).

Topics included in the review are: techniques for improved data acquisition, handling, and reporting; solid-state membrane, nonglass electrodes and applications; glass electrodes (macro and micro) for hydrogen and cation activity measurements; sensitized electrodes using interposed chemical reactions; semiconductor electrodes; liquid ion-exchange membrane electrodes; apparent neutral carrier membranes; conventional electrodes of zeroeth, first, second, and third kinds including reference electrodes; electrodes in non-aqueous solvents; potentiometric standards and less common reagents in titrimetry; and some new departures and fundamental problems in potentiometry. (1272 references) (LK)

2552 CHROMATOGRAPHY. Zweig, G. (Environmental Protection Agency, Washington, DC); Sherma, J. Anal. Chem.; 46: No. 5, 73R-94R(Apr 1974).

This review covers liquid column chromatography, paper chromatography, and thin-layer chromatography (excluding ion exchange). (1121 references) (LK)

2553 ELECTRON SPECTROSCOPY: X-RAY AND ELECTRON EXCITATION. Hercules, D. M.; Carver, J. C. (Univ. of Georgia, Athens). Anal. Chem.; 46: No. 5, 133R-150R(Apr 1974).

The field of x-ray excited electron spectroscopy is reviewed for the 1972–1973 period. This review covers all literature abstracted in Chemical Abstract starting with the December 23, 1971, issue through the December 10, 1973, issue. Some of the literature on applications of Auger spectroscopy is included. (545 references) (LK)

2554 EMISSION SPECTROMETRY. Barnes, R. M. (Univ. of Massachusetts, Amherst). Anal. Chem.; 46: No. 5, 150R-192R (Apr 1974).

This review covers publications appearing during 1972–73. Areas covered are: spectral descriptions and classifications; instrumentation; standards, samples, and calibration; excitation sources; and spectrochemical analysis. (1711 references) (LK)

2555 FLAME SPECTROMETRY. Winefordner, J. D. (Univ. of Florida, Gainesville); Vickers, T. J. Anal. Chem.; 46: No. 5, 192R-227R(Apr 1974).

Fundamental studies, atomic and molecular emission spectrometry, atomic absorption spectrometry, and atomic fluorescence spectrometry are reviewed. Tables are included on applications of flame atomic emission, flame molecular emission, flame atomic absorption, microsamping techniques, flame atomic fluorescence, and flameless atomic fluorescence. The literature reviewed covers the period November 1971 through October 1973. (989 references) (LK)

2556 LIGHT ABSORPTION SPECTROMETRY. Boltz, D. F. (Wayne State Univ., Detroit); Mellon, M. G. Anal. Chem.; 46: No. 5, 227R-248R(Apr 1974).

This review of light absorption spectrometry covers the period November 1971 through November 1973. The subject matter is classified under the headings chemistry, physics, and applications. (800 references) (LK)

2557 MASS SPECTROMETRY. Burlingame, A. L. (Univ. of California, Berkeley); Cox, R. E.; Derrick, P. J. Anal. Chem.; 46: No. 5, 248R-287R(Apr 1974).

The review is divided into the following subjects: techniques, instruments, and computers; ion chemistry–unimolecular processes; ion chemistry–bimolecular and higher molecularity reactions; analytical applications in biomedicine; analytical applications to natural products; and environmental applications. (1647 references) (LK)

2558 KINETIC POLAROGRAPHIC URANIUM WAVE IN PRESENCE OF CHLORATE IONS. Manok, F.; Varhelyi, C.; Kerecsendi, G. (Babes-Bolyai Univ., Cluj). Monatsh. Chem.; 104: No. 5, 1307-1314(Sep 1973). (In German).

An increase of the 2nd polarographic uranium(VI) wave was observed in the presence of chlorate ions in $HClO_4$–$NaClO_4$, or $HClO_4$–$NaClO_4$–NaCl supporting electrolyte, respectively. The polarographic measurements at different temperatures and at various perchloric acid concentrations show that this increase is due to a kinetic U(III)–U(IV) current. The activation parameters of the U(III)–U(IV) oxidation reaction with ClO_3^- were calculated using Kautecky's method. The approximately five-fold increase of the 2nd polarographic wave allows the determination of small amounts of uranium (10^{-5} to 10^{-6} mole/l). (auth)

2559 EXTRACTION WITH LONG CHAIN AMINES. VII. Polarographic Determination of Uranium. Pribil, R. Jr.; Adam, J. (Charles Univ., Prague). Talanta; 20: No. 12, 1338-1341(Dec 1973).

A polsrographic determination of uranium is described, based on the highly selective extraction of uranium(VI) with a chloroform solution of trioctylammonium chloride, followed by re-extraction of uranium into an aqueous 0.5M KCl–0.5M HCl solution, which also serves as the polarographic supporting electrolyte. In this medium, uranium (VI) is reduced at the dropping mercury electrode to give two polarographic waves, the first of which is of analytical significance. In this way it is possible to determine 50 to 2400 μg of uranium in 1 ml of supporting electrolyte and in the presence of large amounts of accompanying elements. (auth)

2560 CONVENIENT METHOD FOR THE SEPARATION OF YTTRIUM-90 IN SEAWATER. Bauman, A. (Yugoslav Academy of Sciences and Arts, Zagreb). Health Phys.; 26: No. 5, 472(May 1974).

An innovation is presented for the determination of ^{90}Sr in seawater by final precipitation of ^{90}Y with ammonium cinnamate. The method of separation is given. The advantage of ^{90}Y precipitation as $Y(C_6H_5CH{=}CHCOO)_3$ consists in its simplicity, thermal stability until 200°C, and insolubility except in 0.2% cinnamic acid. Neither stable strontium and calcium nor ^{90}Sr coprecipitate under these experimental conditions. The ^{90}Y yield as $Y(C_6H_5CH{=}CHCOO)_3$ was 96 ± S.D. Ammonium cinnamate can be considered as a convenient reagent for a neat separation of ^{90}Y from seawater. (UK)

2561 USE OF ION EXCHANGE FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS. III. Thorium. Korkisch, J.; Dimitriadis, D. (Univ., Vienna). Talanta; 20: No. 12, 1303-1308(Dec 1973). (In German).

A method is described for separation of ppB levels of thorium from natural waters and a spectrophotometric finish. A 1-liter water sample is acidified with nitric acid and filtered, then evaporated, and the thorium adsorbed on Dowex 1-X8 strongly basic anion-exchanger (nitrate form) from 8M nitric acid to separate it from accompanying elements. The thorium is eluted with 6M hydrochloric acid and determined spectrophotometrically by the Arsenazo III method. The method has been applied to determination of thorium at the 0.4 to 4.5 ppB level in Austrian natural waters. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 3154, 3305–3307, 3309, 3310, 3362, and 3766.

2562 (BARC/I-241) ANALYSIS OF U-235 CONTENT OF OXIDE PELLETS AND POWDERS BY GAMMA RAY SPECTROMETRY AND AN EVALUATION OF THE RESULTS BY OTHER METHODS. Reddy, G. R.; Sankar Das, M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

Procedure for the analysis of ^{235}U concentrations of two uranium oxide pellets of unknown enrichments by gamma spectrometry is described. Results are evaluated and compared with those derived by other methods. (INIS)

2563 (CEA-CONF-2590) SIMULTANEOUS DETERMINATION BY X FLUORESCENCE OF SEVERAL ELEMENTS IN A MIXED COMPOUND OF THE GARNET TYPE. Florestan, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 28 Apr 1972. 21p. (In French). (CONF-730571-3). Dep. NTIS (US Sales Only) $4.25.

From colloquium on x rays and matter; Monte Carlo, Monaco (22 May 1973).

The problem of the simultaneous determination of several elements by x-ray fluorescence in a mixture of the garnet type using a single series of standards calculated by adequate criteria was studied. The FORTRAN program for the calculation of the standards is given and the criteria used in its formulation are discussed. The elements determined were Nb, Dy, Mn, and Al in a garnet structure. The use of scattered Compton radiation as a reference makes possible very linear calibration curves to be traced in spite of the variations of the total absorption coefficient of the matrix. (JSR)

2564 (CEA-N-1608) RADIOPOLAROGRAPHIC DETECTOR: APPLICATION TO ON-LINE MEASUREMENT OF THE SPECIFIC ACTIVITY OF CHROMATOGRAPHIC ELUATES. Prigent, Y. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Jan 1974. 17p. (In French). Dep. NTIS (US Sales Only) $4.00.

A continuous detection apparatus utilizing two circulation cells in series is presented. One of these cells is contained in a NaI crystal well and enables γ activities to be detected. The other cell is polarographic and provided with three electrodes. The equipment is also provided with an auxiliary reagent mixer, a deaerating device, and a thermostatic jacket. The polarographic parameters of cadmium and cobalt solutions were studied. The performance of the device was studied by measuring the specific activity of ^{58}Co labeled Co (5.10^{-7} to 10^{-4} gram atoms of Co + 5.10^{-3} to 1 μCi of ^{58}Co) at the exit of the chromatographic column. (FR)

2565 (INIS-mf-887-1, pp 109-117) POSSIBLE DETECTION OF LOW ACTIVITY OF CERTAIN BIOLOGICALLY IMPORTANT RADIOISOTOPES BY MEASURING CHERENKOV RADIATION. Mertl, F. (Karlova Univ., Plzen, Czech.). [nd]. (In Czech).

A possible application is discussed of the Cherenkov radiation in the determination of the low activity of certain radionuclides emitting beta radiation having a maximum energy of several MeV. The results are reported of a test detection of ^{40}K and of $^{90}Sr + ^{90}Y$ in water and a possible resolution of two emitters is shown by an example of the $^{24}Na + ^{42}K$ pair. The measurement can be carried out using a liquid scintillation spectrometer designed for measuring ^{3}H by liquid scintillators. The sample

preparation is simple and inexpensive. The Cherenkov radiation quenching is caused by a lesser number of substances than in the measurement using liquid scintillators. In the determination of the magnitude of quenching the same methods can be applied as in liquid scintillation (i.e., the ratio of the rate of two channels and of an external standard). (INIS)

2566 (JAERI-M-5440) METHOD FOR SEPARATION OF RADIOCESIUM BY USING H_2PtCl_6. Application of the Proposed Method to the Detection of a Leaker Fuel Assembly in BWR plant. Ishiwatari, N. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 13p. (In Japanese). NTIS (US Sales Only).

In BWR plants, the canning method is generally used to detect a leaker fuel assembly. Radioiodine in the sample water from the can is thus measured by radiochemical analysis. When radiocesium in the water is also measured, this detection becomes more effective. A procedure of separation of the cesium is described; in the case of a fuel rod, holes are made through the cladding. The sample water is first filtered. Cesium carrier-solution and HCl are then added to the filtrate, which is then reduced to 20 to 30 ml in volume by evaporation. Uranium in excess of 10 mg in the solution must be eliminated. Other radioactive substances in the solution are scavenged with $Fe(OH)_3$, $Ce(OH)_4$, and $ZrO(OH)_2$. After filtering, H_2PtCl_6 solution is added. The pH of the solution is adjusted to 10 by adding NaOH solution. Precipitate is filtered off with a weighed filter paper. After measuring the chemical yield, the activity is measured by gamma spectrometry, to determine the radiocesium content. (auth)

2567 INHERENTLY STABLE SYSTEM FOR MEASURING TISSUE IODINE USING ITS K-ABSORPTION EDGE. Oldendorf, W. H.; Phelps, M. E.; Hoffer, P. B.; Tanaka, H. (Wadsworth Hospital, Los Angeles). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 583-588(Mar 1974).

An experimental system for detection of small concentrations of iodine in tissue is described. A collimated beam of lanthanum Ka1 and Ka2 x rays is passed through phantoms of iodine and water. The energies of these 2 x rays straddle the K-absorption edge of iodine and are differentially absorbed by the iodine phantom. After emerging from the phantom, the 2 x rays are separated by a stable iodine filter placed in the beam path with resulting photoelectric absorption of the Ka1 x rays on the high side of the K-edge of iodine. This results in production of isotropically propagated iodine fluorescence x rays, which are counted by a surrounding NaI(Tl) crystal-photomultiplier detector. The Ka2 x rays are counted by a second, more distant detector. The ratio of the Ka2/Ka1 x rays is determined by simultaneously counting the scintillations produced in these 2 detectors. In the phantom, an iodine concentration of 1 mg/cm^2 produces a change in this ratio of about 3 per cent. The change in this ratio is about 1,000 times greater and in the opposite direction for iodine in the beam path relative to an equivalent amount of water. The system is inherently stable because the original photon energies and the separation threshold are established by the electron shell energies of lanthanum and iodine. Technical advantages and disadvantages of this system are discussed. (auth)

2568 LIQUID SCINTILLATION COUNTING. Volume 2. Proceedings of a Symposium, Brighton, England, September 13–16, 1971. Crook, M. A.; Johnson, P.; Scales, B. (eds.). London; Heydens and Son Ltd. (1972). 334p. (CONF-710991-P2). $24.00.

Separate abstracts were prepared for each of the twenty-seven papers presented at the symposium. (LK)

For abstracts of individual papers see: 2569–2584, 3301–3310, and 3728.

2569 LIQUID SCINTILLATION COUNTING AS AN ABSOLUTE METHOD. Gibson, J. A. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 23-37 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

It seems feasible that most isotopes that decay by β emission can be counted absolutely in a liquid scintillation counter. A precision of ±5% is attainable for tritium and this could be improved to ±2% with careful investigation of various factors in the system. Errors of ±2% for ^{14}C and ±1% for ^{36}Cl have been found, but these measurements could be improved to the 0.1% level if the efficiency of the system is carefully measured. (LK)

2570 ESTIMATION OF ATP, ADP, AND AMP IN HUMAN PLASMA USING LUCIFERIN/LUCIFERASE AND A SCINTILLATION COUNTER. Parkinson, P. I.; Medley, E. (Middlesex Hospital, London). pp 109-113 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

With this method, the range of normal values for ATP in human plasma is 0.2 to 1.2 μg/ml. Normal values for ADP in human plasma are 0.05 to 0.7 μg/ml and there is negligible AMP in resting human plasma. The method has a standard error of ±13% at 0.2 μg and ±7% at 2.5 μg. Since the values for ADP and AMP are obtained by subtraction of repeated estimations of ATP, the sensitivity of the method for ADP is a function of the sum of ATP and ADP, and the sensitivity of the method for the estimation of AMP is a function of the sum of ATP, ADP, and AMP. (LK)

2571 SEMI-AUTOMATIC MICROTRANSFERATOR AND CELL FOR THE BIOLUMINESCENCE ASSAY OF ATP AND REDUCED NAD WITH SCINTILLATION COUNTERS. Schram, E.; Roosens, H. (Vrije Univ., Brussels). pp 115-120 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The special cell and transfer device are described. The sensitivity of bioluminescence as an analytical tool depends on the proper use of the counting equipment and also on the reagents. (LK)

2572 METHODS OF SAMPLE PREPARATION OF INORGANIC MATERIALS INCLUDING CHERENKOV COUNTING. Dyer, A. (Univ. of Salford, Eng.). pp 121-137 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The review covers the radiochemical determination of inorganic isotopes by liquid scintillation counting. Cases where the isotopes are recovered as inorganic materials from biological materials are included. The recovery of ^{45}Ca as calcium chloride from milk and that of iron isotopes as ferric chloride from blood are two examples of this general technique. (146 refs.) (LK)

2573 LIQUID SCINTILLATION COUNTING OF LOW LEVELS OF CARBON-14 FOR RADIOCARBON DATING. Burleigh, R. (British Museum, London). pp 139-146 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The preparation and measurement of samples are described, and the principles of radiocarbon dating are outlined. (LK)

2574 LIQUID SCINTILLATION COUNTING OF CALCIUM-45 IN BIOLOGICAL SAMPLES CONTAINING ENVIRONMENTAL STRONTIUM-90. Nolan, J. (Medical Research Council Radiobiology Unit, Harwell, Eng.). pp 147-154 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The method described was developed to measure low specific activities of ^{45}Ca in human excreta containing ^{90}Sr. Calcium is separated from biological samples as the oxalate, converted to the chloride, and dissolved in ethanol. A toluene-based scintillator solution is added and the sample is counted. The detection limit of the method (i.e., when the ^{45}Ca rate = 10% of the background) is a 3.3 pCi/g calcium. (LK)

2575 SIMULTANEOUS DETERMINATION OF PLUTONIUM ALPHA ACTIVITY AND PLUTONIUM-241 IN BIOLOGICAL MATERIALS BY GEL SCINTILLATION COUNTING. Eakins, J. D.; Lally, A. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 155-165 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The method described utilizes a simple gel scintillation counting technique simultaneously to determine both plutonium alpha activity and ^{241}Pu in a two-channel Packard Tricarb Model 3214 liquid scintillation spectrometer. By using the procedure given, alpha-emitting plutonium at the 1-pCi level and ^{241}Pu at the 10-pCi level of activity can be adequately detected. (LK)

2576 TECHNIQUES FOR COUNTING CARBON-14 AND PHOSPHORUS-32 LABELLED SAMPLES OF POLLUTED NATURAL WATERS. Curtis, E. J. C.; Toms, I. P. (Dept. of the Environment, Stevenage, Eng.). pp 167-180 of Liquid Scintilla-

tion Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Techniques involving Cherenkov counting of aqueous ^{32}P and solubilization techniques which allow liquid scintillation counting of biological materials, in particular ^{32}P in biological slime growths and ^{14}C in algae, are discussed. (LK)

2577 APPLICATION OF CHERENKOV TECHNIQUE TO CONTINUOUS MEASUREMENT OF RADIOACTIVE ISOTOPES ISOLATED BY AN AUTOMATIC ANALYTICAL PROCESS. Colomer, J.; Cousigne, M.; Metzger, G. (CEA, Paris). pp 181-187 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

On-line detection by Cherenkov counting of radioactive isotopes as they are isolated is a practicable and useful technique in the CBA automatic analytical process based on the substoichiometric separation in conjunction with non-active isotope dilution. The measurement is performed versus a standard activity of the same radioelement treated under the same experimental conditions; it consists of a simple comparison between two count rates whose ratio is equal to the specific activity ratio of the two flowing streams which is in turn identical to the ratio of the initial activities. (LK)

2578 SAMPLE PREPARATION TECHNIQUES IN BIOCHEMISTRY WITH PARTICULAR REFERENCE TO HETEROGENEOUS SYSTEMS. Fox, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 189-204 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

General aspects of the use of solubilizers, disc counting, and suspension techniques are discussed; some of the techniques found to be useful in analytical and preparative procedures involving chromatography, electrophoretic, and centrifugation methods are described; and some aspects of the technique of colloid scintillation counting are described in detail. (LK)

2579 LIQUID SCINTILLATION COUNTING OF BIOLOGICAL MACROMOLECULES: EXTRACTION FROM AQUEOUS SOLUTION AND FROM GLASS FIBRE FILTERS. Paus, P. N. (Univ. of Oslo). pp 205-212 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Liquid scintillation counting of RNA, DNA, and proteins after extraction from aqueous solutions and glass fiber filters is discussed. Extraction from aqueous solutions into an organic phase is accomplished by shaking with a mixture of Soluene-100 or N.C.S. in n-pentanol or n-hexanol. Elution from glass fiber filters is accomplished by incubation with quaternary ammonium base solubilizers. These methods abolish energy absorption by filters or precipitates, give high counting efficiencies, and allow double-labelling experiments to be performed with greater accuracy. (LK)

2580 ESTIMATION OF SMALL QUANTITIES OF CARBON-14 LABELLED ADENINE NUCLEOTIDES FOLLOWING THEIR SEPARATION BY ION EXCHANGE PAPER CHROMATOGRAPHY. Carney, G. C. (Bristol Polytechnic, Eng.). pp 213-215 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The fact that the separation and estimation of the nucleotides derived from trace amounts of ADP is well within the scope of the teaching as well as the research laboratory is emphasized. A typical experiment for studying the efficiency of oxidative phosphorylation is given. (LK)

2581 SAMPLE PREPARATION FOR TRITIUM COUNTING IN THE APPLICATION OF THE DIGOXIN RADIOIMMUNOASSAY TECHNIQUE OF LYSED BLOOD. Phillips, A. P.; Sambrook, C. A. (Home Office Central Research Establishment, Aldermaston, Eng.). pp 217-222 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The following topics are discussed: materials, counting methods, radioimmunoassay method, choice of scintillator for normal horse serum supernatants, scintillation counting of hemolyzed supernatants, and Triton emulsion systems. (LK)

2582 DYNAMICS OF QUENCHING BY PLASMA FROM PATIENTS WITH VARIOUS PATHOLOGICAL CONDITIONS. Assailly, J.; Bader, C.; Funck-Brentano, J. L.; Pavel, D. (Hopital Necker, Paris). pp 223-231 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The methods used for direct plasma sample preparation, counting efficiency measurement, and quench correction are described. Results are discussed which show that at least for clinical studies, counting efficiencies vary widely. Color changes in plasma samples cause the quenching. Calculation of dpm from cpm in labelled plasma samples is discussed. (LK)

2583 FACTORS INFLUENCING THE DETECTION OF INCORPORATED ^{3}H-THYMIDINE IN BIOLOGICAL MATERIAL. Cope, W. A.; Double, J. A. (St. Mary's Hospital Medical School, London). pp 233-243 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Although results from the study show that sample preparation can influence the activity detected when measuring ^{3}H-thymidine labelled DNA, this does not invalidate techniques using ^{3}H-thymidine labelled DNA providing they are internally controlled and absolute values are not required. (LK)

2584 DETERMINATION OF STATISTICAL PRECISION OF TRITIUM D.P.M. IN DUAL LABELLED SAMPLES WITH VARIABLE ISOTOPE RATIOS AND QUENCHING. Assailly, J.; Bader, C.; Funck-Brentano, J. L.; Pavel, D. (Hopital Necker, Paris). pp 293-301 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The automatic estimation, using a computer, of the relative standard deviation (RDS) of tritium activity in dpm of a series of dual isotope samples (^{3}H, ^{14}C), where isotope ratio and quenching vary simultaneously, is discussed. The method of estimation is based on the implicit relationship between the RSD of the tritium activity, the count rate (cpm) ratio in the two counting channels A and B, quenching, and the counting statistics of channels A and B. (LK)

2585 METODY RADIOIZOTOPNOGO ANALIZA PRODUKTOV NEITRONNOI AKTIVATSII I DELENIYA. (Radioisotopic Analysis of Products of Neutron Activation and Neutron Fission). Rovinskii, F. Ya. (ed.). Moscow; Atomizdat (1973). 256p.

Methods and procedures for the radioisotopic analysis of objects from the environment (air, soil, water, and biomaterials) are reviewed in a systematic form. Methods of scintillation and semiconductor γ spectrometry and α and β spectrometry are examined. Practical methods for the radiochemical analysis of more than 40 isotopes found in nature are discussed. Methods based on the principle of complex use of radiochemistry and spectrometry made it possible to increase substantially the productivity and reliability of radioisotopic analysis and seem irreplaceable in the determination of some radioisotopes. Methods of sampling, concentration, and measurement of tritium in the environment are described. Practical recommendations are made on the determination of radioisotopes of inert gases in the air. (tr-auth)

2586 ANALYSIS OF THE SITE OCCUPANCY OF MINOR ELEMENTS IN MINERALS. Duncan, J. F.; Johnston, J. H. (Victoria Univ. of Wellington, New Zealand). Radiochem. Radioanal. Lett.; 17: No. 2, 111-120 (20 Apr 1974).

Analytical methods based on Moessbauer absorption were developed to determine where minor elements are sited in a crystal. The methods are (i) the precision determination of the quadrupole peak area ratio and (ii) the determination of the relative contributions of Rayleigh and nuclear scattering at the Bragg angle. As well, the former allows certain chemical parameters to be determined, the latter the phase of the diffracted radiation. These methods were extended to x-ray resonance diffraction using anomalous scattering effects, which is applicable to a very large number of elements. All methods were applied to analyze the site occupancy in the aluminosilicate minerals olivine, cordierite, and tourmaline. Some further possibilities are outlined. (auth)

2587 NONDESTRUCTIVE DETERMINATION OF THE AREAL DENSITY OF ^{235}U FILMS. Nelson, G. C. (Sandia Labs., Albuquerque, NM). Radiochem. Radioanal. Lett.; 17: No. 2, 129-133 (20 Apr 1974).

A simple, rapid, and nondestructive method has been developed for measuring the areal density of enriched uranium films. With this method, precisions of 3 or better can routinely be obtained for ^{235}U areal densities between 4 and 75 mg/cm^2. (auth)

2588 METHOD FOR THE CONTINUOUS ANALYSIS OF THE ELEMENTARY COMPOSITION OF LIQUIDS BY NUCLEAR RADIATION ABSORPTION. Balint, T. D.; Gersey, F. (to Magyar Asvanyolajes Foldgaz Kiserleti Intezet). British Patent 1,339,449. 5 Dec 1973. Filed date 27 Jan 1971. 6p.

Some disadvantages of previous methods are stated. In the method described two bodies of different specific gravity, connected to one another, are arranged in the liquid to be analyzed. Variations in the buoyancy forces acting on these bodies due to variations of the specific gravity of the liquid, cause, in conjunction with mechanical means, variations of the thickness of the layer of the liquid being analyzed through which passes the radiation in a predetermined direction and with a predetermined incident intensity whereby the weight per unit surface area of the liquid layer remains substantially constant. The apparatus comprises a pressure container, filled with the liquid to be analyzed, and arranged for continuous through-flow of the liquid. The container is provided with a two-arm balance, the first arm carrying a counterweight body and the second arm carrying an immersion body of different specific gravity. A radiation source is secured to one of the two arms, with a radiation detector arranged opposite, a layer of the liquid to be analyzed being present between the detector and source, the thickness of the layer being defined by the distance of the source from the detector. The two-arm beam of the balance may be rotatably secured about a knife-edge bearing mounted in a holding strap, and the counterweight may be arranged to be displaceable on the first arm and to be fixable by means of a knurled nut. (UK)

2589 USE OF X-RAY FLUORESCENCE TO DETERMINE TRACE METALS IN WATER RESOURCES. Blasius, M. B.; Kerkhoff, S. J.; Wright, R. S.; Cothern, C. R. (Univ. of Dayton, OH). Water Resour. Bull.; 8: No. 4, 704-714(1972).

The principles and techniques of this method and its advantages over other methods of analysis, particularly the future possibility of a portable unit, are discussed. A bremsstrahlung source (1 Ci of ^{147}Pm in the form of a ceramic bead), a Si(Li) solid-state detector and a 1024-channel analyzer were used to analyze river water for both particulate and ionized trace metals. Standard samples were prepared by vacuum deposition of known amounts (≈100 μg) of the metals on aluminium foil. Millipore and Whatman No. 41 filters were preferred for collecting particulate and suspended metals. Ion-exchange filter-papers were used to collect dissolved metals. For the elements between Tl and Cs in the Periodic Table, the limit of detection was between 20 and 30 parts per 10^9 for metals in the suspended form and between 0.25 and 0.4 ppM for dissolved metals. (Anal. Abstr)

2590 LIQUID SCINTILLATION COUNTING OF HARD β- AND γ-EMITTING RADIONUCLIDES IN BIOLOGICAL SAMPLES. Francois, B.; Ghizzo, M. (Hopital de l'Antiquaille, Lyon). Int. J. Nucl. Med. Biol.; 1: No. 3, 147-152(Feb 1974).

The technique of liquid scintillation spectrometry was studied to find a possible loss of efficiency of a given element in plasma and urine, compared with the response of the same source in transparent solutions. The following hard β or pure γ emitters commonly met in medical or biological practice were studied: ^{42}K, ^{24}Na, ^{47}Ca, ^{198}Au, ^{22}Na, ^{131}I, ^{82}Br, ^{64}Cu, ^{59}Fe, ^{58}Co, ^{85}Sr, ^{51}Cr, ^{75}Se, ^{169}Yb, ^{99m}Tc. The technique was also used in 50 patients given an oral dose of ^{24}Na for "Exchangeable Sodium" determinations, and the relative merits of liquid scintillation counting and γ-spectrometry are discussed. Liquid scintillation is recommended for counting 2 ml or less of blood serum loaded with ^{22}Na, ^{24}Na, ^{42}K, ^{131}I and for counting 4 ml of serum with ^{42}K and perhaps ^{131}I. (UK)

2591 DETERMINATION OF VARIOUS IMPURITIES IN SODIUM METAL BY X-RAY FLUORESCENCE SPECTROSCOPY. Schneider, H.; Borgstedt, H. U. (Kernforschungszentrum, Karlsruhe, Ger.). pp 77-80 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

A method is described for the determination of many elements in the μg range by x-ray fluorescence spectroscopy after chemical enrichment. The procedures, detection limits, and reproducibilities are indicated. Analyses of sodium samples of commercial quality, and from various loops, are reported and critically discussed. (auth)

2592 DETERMINATION OF CARBON MONOXIDE IN AIR BY THE RADIORELEASE METHOD. Naoum, M. M.; Pruzinec, J.; Toelgyessy, J.; Klehr, E. H. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 17: No. 1, 87-93(10 Apr 1974).

Several oxidizing agents were kryptonated and allowed to react with carbon monoxide. Hopcalite is a surface catalyst for the oxidation of carbon monoxide. When the kryptonated hopcalite was subjected to a continuous stream of CO, no release of ^{85}Kr was observed. Iodine pentoxide kryptonate reacted unreproducibly due to the difficulties in obtaining a homogeneous anhydrous kryptonate. The activity left on a paper impregnated with radioactive kryptonate of HgO decreased after subjection to an atmosphere of CO. On the other hand when a stream of CO in air was passed through kryptonated HgO, ^{85}Kr could be detected by a GM flow-counter. Currently the HgO method was studied by measuring either the released or residual activity left on the paper, and the interferences caused by other air pollutants. (auth)

2593 MOESSBAUER SPECTROMETRY. Stevens, J. G. (Univ. of North Carolina, Asheville); Bowen, L. H. Anal. Chem.; 46: No. 5, 287R-314R(Apr 1974).

This review of Moessbauer spectrometry includes sections on instrumentation and spectral analysis routine usage, interpretation of Moessbauer parameters, lattice dynamics, phase studies and site characterization, amorphous materials and frozen solutions, temperature extremes, effects of irradiation, and diffraction and interference effects. Tables of nuclear parameters for observed Moessbauer transitions, chemicals applications of ^{57}Fe Moessbauer spectrometry (1972–1973), chemical applications of ^{119}Sn Moessbauer spectrometry (1972–1973), and chemical applications of other Moessbauer isotopes (1972–1973) are included. (839 references) (LK)

2594 ENZYMES IN ANALYTICAL CHEMISTRY. Fishman, M. M.; Schiff, H. F. (City Coll., New York). Anal. Chem.; 46: No. 5, 367R-393R(Apr 1974).

The literature for the period January 1972 through December 1973 on the use of enzymes is reviewed. The review is in the form of a table having the following column headings: enzyme, method, substrate, assay, comments, and reference. Radiometric methods are used for labelled substrates. (LK)

2595 ANALYSES OF FISSILE MATERIALS RECEIVED AND THE PREPARATION OF STANDARDS. Huart, A. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 188, 53-58 (Jan 1974). (In French).

The Central Analysis and Control Laboratory (LCAC) was set up in 1960 for the analysis (under contact) of nationally and internationally exchanged nuclear materials including plutonium. A hot laboratory with six cells and fifty glove boxes is available for handling plutonium together with all the facilities necessary for the different analyses to be performed: wet analysis, emission spectrometry, electrochemistry atomic absorption, specific area measurements, and purification. In addition, the laboratory is charged with the responsibility of fabricating and controlling plutonium oxide standards for CEA laboratories and industry. (Fr)

2596 CONCENTRATION THERMORADIOMETRY AND THERMORADIOMETRIC TITRATIONS. Toelgyessy, J.; Dilliger, P.; Lesny, J. (Slovenska Vysoka Skola Technicka, Bratislava). Radioisotopy; 14: No. 2, 245-263(1973). (In Czech).

The basic principles and first experimental results of new radioanalytical methods, concentration thermoradiometry (TRM) and thermoradiometric (TRM) titration, are described. The investigated solution or reagent containing a dissolved radioactive inert gas (e.g., krypton, xenon or radon) is analyzed for gas solubility. The analysis is based on temperature changes accompanying the chemical reactions and is performed by measurement of the activity of the released gas or of the residue activity of the analyzed system. The method of calibration curves or titrations may be used in the analysis. The method is illustrated on an example of neutralisation TRM titration and determination of gas moisture by concentration TRM. The determination sensitivity is better than in the classical thermometric method and is applicable also to microscale analysis. (auth)

2597 ACTIVITY DETERMINATION OF SOME BETA EMITTERS IN AQUEOUS SOLUTIONS AND OTHER LIQUID BY MEANS OF CHERENKOV RADIATION DETECTION. Merti, F. (Karlova Univ., Plzen, Czech.). Radioisotopy; 14: No. 3, 491-501(1973). (In Czech).

The disadvantages of sample preparation and counting by means of Geiger–Müller tubes and liquid scintillators are discussed. To eliminate some of the disadvantages, a method using the detection of Čerenkov radiation is proposed. The conditions of occurrence of Čerenkov radiation and the circumstances affecting its intensity and spectral distribution are briefly described. The

possibility of measuring up to 20 mls of samples of various liquids, which may be reused after measurement, is stressed. The absence of chemical quenching permits counting of both acid and alkaline solutions. In colored samples a correction for color quenching has to be assessed. The commonly used detection methods are described and discussed. (auth)

2598 CRYSTAL ANALYSIS BY CHARGED PARTICLES. Habanec, J. (Czechoslovak Academy of Science, Rez); Hrbek, J. Radioisotopy; 14: No. 3, 503-523(1973). (In Czech).

By combining the method of back-scatter and the channeling effect, germanium single crystal, thin layer of silicon nitride on a Si single crystal base, and a single crystal base with implanted xenon were studied. A 2-3 MeV proton beam from a Van de Graaff accelerator was used for the analysis. In addition to the qualitative and quantitative analysis, this method was used to determine structural parameters. The content and localization of oxygen atoms in the germanium lattice, as well as the composition and impurities in the thin layer and in the implanted base were determined by this method. The results are evaluated and compared with the results of some foreign laboratories employing this method, which is applied mainly to analytical studies in solid phase and in electronics. (auth)

2599 CORRECTION METHOD CONSIDERING THE MATRIX EFFECT IN X-RAY FLUORESCENCE ANALYSIS. Kis-Varga, M.; Bacso, J. (Magyar Tudomanyos Akademia, Debrecen, Hungary). Izotoptechnika; 17: No. 2, 83-92(Feb 1974). (In Hungarian).

The correction of the matrix effect by the iteration method is discussed. A ^{125}I source was used for excitation and the measurements were carried out by Si/Li detectors. The nondestructive analysis of Mn-nodules is described. (auth)

2600 PHENOMENOLOGICAL GAMMA SPECTRA EVALUATION OF A MIXTURE OF NUCLIDES. Pisutova, N. (Katedra Jadrovej Fyziky, Bratislava). Radioisotopy; 14: No. 4, 649-656 (1973). (In Slovak).

A method is suggested for the determination of the composition of a mixture of nuclides. The technique is based on analysis by means of the least squares method. It differs from the current methods as the contribution from nuclides lying outside the investigated spectral region is phenomenologically defined by a curve having a nonlinear dependence on a number of parameters. The method was tested on a mixture of nuclides Tb, Hf, In with an "unknown" background from Ag. The resulting determinations of the individual components differ from reality by 0.3%, 4%, and 1%, respectively. (auth)

Separation Procedures

Refer also to abstracts 2687, 2699, 2776, 2788, 2794, 2822, and 3303.

2601 ANALYTICAL USES OF SOME N-NITROSO-N-ALKYL (OR -N-CYCLO-ALKYL) HYDROXYLAMINES. Part II. Solvent Extraction of Metal Hexahydrocupferrates. Buscarons, F.; Canela, J. (Univ. of Barcelona, Spain). Anal. Chim. Acta; 70: 113-120(1974).

The extraction of the hexahydrocupferrates of 17 metals (Cu, Pb, Bi, Sb, Al, Ti, Fe, Co, Ni, Mn, W, Mo, V, Ca, Sr, Ba and Mg) with chloroform is studied in relation to pH values. The extraction constants are calculated and compared with those of cupferron; these can be used to determine the optimal conditions for the separation of many metals. As examples of analytical applications, extractive separations of trace amounts of Sb(III), Bi and Al from, respectively, Pb, Pb and Co were checked. A single extraction allows the removal of major amounts of some metals (Fe, Th and Zr) which interfere in the compleximetric titration of divalent metals (Mn, Zn, Mg, Cd, Pb and Co). (auth)

2602 EXTRACTION OF RADIUM FROM NATURAL WATERS USING MANGANESE-IMPREGNATED ACRYLIC FIBERS. Moore, W.S.; Reid, D.F. (U. S. Naval Oceanographic Office, Ocean Floor Analysis Division Chesapeake Beach, Maryland 20732). J. Geophys. Res. 78: No. 36, 8880-8886 (20 Dec 1973).

Acrylic fibers impregnated with manganese oxide-dioxide extract radium and other trace elements from natural waters. This extraction technique may be used to quantitatively extract radium from 20-liter water samples for precise ^{226}Ra analysis and to concentrate radium from several-thousand-liter samples for $^{228}Ra/^{226}Ra$ activity ratio determinations. (auth)

2603 SEPARATION OF MOLYBDENUM(VI), TUNGSTEN(VI), CHROMIUM(VI), AND VANADIUM(V) BY PAPER CHROMATOGRAPHY. Isaeva, K. G.; Viktorova, M. E. (Inst. of Mineralogy, Geochemistry, and Crystallo-Chemistry of Rare Elements, Moscow). Zh. Anal. Khim.; 29: No. 2, 382-384(Feb 1974). (In Russian).

Various systems of solvents based on ketones containing HCl and H_2SO_4 were investigated for separation of Mo(VI), W(VI), Cr(VI), and V(V). Mo(VI), W(VI), Cr(VI) and V(V) are found to be separated by solvents composed of 90 ml acetone, 0.2 to 3.0 ml 6 M HCl and 9.8 to 7.0 ml 1 M H_2SO_4. Tricomponent mixtures Mo(VI)–W(VI)–Cr(VI) and V(V)–W(VI)–Cr(VI) are resolved in solvents of several compositions: 95 ml acetone and 5 to 3 ml 6 M HCl; 90 ml methyl ethyl ketone, 9 to 7 ml 6 M HCl, and 1 to 3 ml 1 M H_2SO_4. (auth)

2604 APPLICATION OF N-CYNNAMOYLPHENYLHYDROXYLAMINE IN ANALYTICAL CHEMISTRY. IX. Precipitation and Separation of Titanium, Zirconium, and Gallium from Metals of the Third Analytical Group. Kulumbegashvili, V. A.; Ostroumov, E. A. (Inst. of Oceanology, Moscow). Zh. Anal. Khim.; 29: No. 2, 263-268(Feb 1974). (In Russian).

N-cynnamoylphenylhydroxylamine (CPHA) quantitatively precipitates titanium from 4–12 N HCl or 10–12 N H_2SO_4 as disubstituted inner complex orange salt $TiO(C_{15}H_{12}\cdot O_2N)_2\cdot HCl$ giving yellow $TiO(C_{15}H_{12}O_2N)_2$ and HCl when treated with water. Zirconium is precipitated from 3 N HCl or 1 N H_2SO_4 solutions as tetrasubstituted yellow salt $Zr(C_{15}H_{12}O_2N)_4$. In HCl or H_2SO_4 solutions with pH ≥ 2 gallium forms tersubstituted yellow salt $Ga(C_{15}H_{12}O_2N)_3$. The supposed structures of metal derivatives of CPHA were confirmed with ir-spectroscopy. New methods of separation of titanium, zirconium, and gallium from other metals were worked out and checked on both natural and technical samples. (auth)

2605 EXTRACTION OF RARE EARTHS WITH TRIBUTYL PHOSPHATE FROM A NITRATE–PERCHLORATE MEDIUM. Genov, L.; Sachariewa, M. (Chemical and Technological Inst., Sofia). Monatsh. Chem.; 104: No. 2, 470-476(Mar 1973). (In German).

The extraction of Pr and Yb with TBP from a nitrate-perchlorate medium at an ionic strength of 3.5M and constant concentration of the extraction agent has been investigated. It was found that in the organic phase, besides the simple tri- and hexasolvates, the mixed nitrate-perchlorate solvates of the following compositions are also formed: $Ln(NO_3)_3(ClO_4)\cdot 3$ TBP; $Ln(NO_3)(ClO_4)_2\cdot 3$ TBP; $Ln(NO_3)\cdot(ClO_4)_2\cdot 6$ TBP; $Ln(NO_3)_2(ClO_4)\cdot 6$ TBP. The activity coefficients of the extracted salts, at a constant ionic strength remain unchanged, irrespective of the change of ratio between their anions. (auth)

2606 SYNERGISTIC EXTRACTION OF LANTHANIDES WITH THENOYLTRIFLUORACETONE AND TRIOCTYLAMINE. Genov, L.; Dukov, I. (Chemical and Technological Inst., Sofia). Monatsh. Chem.; 104: No. 3, 750-757(May 1973). (In German).

The synergistic extraction of Pr, Gd, and Yb with a mixture of thenoyltrifluoroacetone and trioctylamine was investigated. The employed solvents were CCl_4, C_6H_6, and $CHCl_3$. The composition of the extracted complexes was determined, likewise, the extraction constants and the formation constants of the complexes. Assumptions about the coordination number of the lanthanides are discussed. Investigation of the influence of the solvents showed that the extraction of one and the same element increases in the order $CCl_4 > C_6H_6 > CHCl_3$. (auth)

2607 EXTRACTION OF ACTINIUM COMPLEX WITH ARSENAZO III IN THE PRESENCE OF DIPHENYLGUANIDINIUM. Karalova, Z. K.; Pyzhova, Z. I.; Rodionova, L. M. Zh. Anal. Khim.; 29: No. 2, 259-262(Feb 1974). (In Russian).

The extraction of actinium as an ion associate formed by the anionic complex of actinium with arsenazo III and diphenylguanidinium cation was studied as a function of the pH of the aqueous solution the solvent nature, and reagent concentration. Actinium is extracted only by oxygen-containing organic solvents; alcohols were proved the most efficient ones. The composition of the extracted compound of actinium, arsenazo III and diphenylguanidinium is 1:1:2. The influence of impurity elements and complex-forming compounds on the extraction has been investigated. (auth)

2608 BISTHMUTHOLS AS ANALYTICAL REAGENTS. VII. Influence of Some Factors on the Extraction of Tellurium(IV) as Naphtylbisthmuthol Complex. Busev, A. I.; Simonova, L. N.; Zayukova, N. D. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 2, 294-299(Feb 1974). (In Russian).

Tellurium(IV) is extracted by naphthylbismuthol in a wide pH range. The extractability depends on the nature of acids and organic solvent, form and concentration reagent, order of mixing of solutions and the time of stirring of phases. In an 8-fold ex-

cess of reagent as potassium salt and at pH 2 to 5 a colored compound soluble in water is formed, which is not extracted into nonpolar organic solvents. The formation of this compound produces minima of extraction curves. Electromigration, electrophoresis on paper, and ion exchange have shown this compound to be a charged complex. (auth)

2609 ADSORPTION OF ELEMENTAL IODINE AND METHYL IODIDE ON ACTIVATED CHARCOAL FROM FLOWING AIR STREAMS AT LOW INLET CONCENTRATIONS. Bellamy, R. R. Columbus, OH; Ohio State Univ. (1973). 178p. University Microfilms Order No. 74-3118.

Thesis (Ph. D.).

The adsorption of elemental iodine and methyl iodide on activated carbons was investigated by experimentally evaluating removal efficiencies of ^{131}I and $CH_3{}^{131}I$ from flowing air streams at low inlet concentrations. The experimental arrangement consisted of a single-pass system through four charcoal beds in series. An analysis of the activity contained on each bed after an experiment permitted the calculation of removal efficiencies. Data are presented to show how removal efficiencies are affected by the variation of certain operating conditions within specified limits. These operating conditions and the ranges studied were inlet concentrations (10^{-9} to 10^{-4} μCi/ml), superficial velocity (5 to 200 fpm), relative humidity (20 to 100%), type of charcoal (vendor), charcoal impregnant (none to metallic oxides), charcoal mesh size (2 × 4 to 28 × 32 Tyler mesh), duration of test (3 to 12 hours) and bed depth (½ to 5 inches). The data presented are correlated by three different methods in an attempt to allow prediction of expected removal efficiencies of a charcoal system with a minimum of experimental data. An empirical correlation based on the experimental results of Gamson-Hougen and a more general correlation based on the j_D mass transfer factor of Colburn fail to correlate the data. Both of these correlations assume that gas-phase diffusion of adsorbate molecules to adsorbent surface is the rate-controlling step of radioiodine adsorption on activated charcoal. When a second step of surface diffusion is presumed to compete with gas-phase diffusion, a successful correlation of the experimental data results. This surface rejuvenation adsorption mechanism is treated from a kinetics viewpoint, and the results (with empirical corrections) are presented graphically to allow prediction of expected charcoal removal efficiencies with a minimum of experimental data. The proposed two-step adsorption mechanism for radioiodine on activated charcoal consists of gas-phase diffusion of adsorbate molecules to adsorbent surface for adsorption at primary active sites followed by regeneration of the adsorption sites by surface diffusion of adsorbate molecules to secondary adsorption sites located inside charcoal pores. The relative success of the surface rejuvenation correlation (with empirical corrections) tends to confirm the proposed surface rejuvenation adsorption mechanism for radioiodine on activated charcoal. (Diss. Abstr. Int., B)

2610 REMOVAL OF IODINE FROM NITRIC ACID SOLUTIONS. Cathers, G. I.; Shipman, C. J. (to United States Atomic Energy Commission). US Patent 3,792,154. Feb 1974. Filed date 6 Mar 1972. 4p.

A method for removing radioactive iodine from nitric acid solution by isotopically diluting the iodine and autoclaving the solution prior to separation is described. (Official Gazette)

2611 METHOD OF SEPARATING THORIUM FROM YTTRIUM AND LANTHANIDE RARE EARTHS. Mason, G. W.; Lewey, S.; Peppard, D. F. (to United States Atomic Energy Commission). US Patent 3,804,940. 16 Apr 1974. Filed date 26 Oct 1972. 6p.

Thorium values are separated from yttrium and from the lanthanide rare earth values contained in an aqueous hydrochloric acid solution with an organic extractant of di(2-ethylhexyl) phosphoric acid in 2-ethylhexanoic acid which preferentially extracts the thorium values while the yttrium and lanthanide rare earth values remain in the aqueous solution. The thorium values are recovered by contacting the thorium-loaded extractant with a 4.0 to 8.0 M hydrochloric acid solution. (Official Gazette)

2612 SORPTION OF PLUTONIUM(IV) BY TIN PHOSPHATE FROM NITRATE SOLUTIONS. Barsukova, K. V.; Krylov, V. N.; Pitalev, V. G.; Rodionova, G. N.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 17: No. 1, 69-76(10 Apr 1974).

The influence of the conditions of preparation (concentration of reagents, the ratio of components in the reaction mixture, pH, temperature, etc.) of tin phosphate on its ability to sorb plutonium(IV) from nitric acid solutions under static conditions was studied. The connection between the form of plutonium(IV) in solution and the completeness of its extraction by the sorbent was also considered. (auth)

2613 ZONE MELTING OF INORGANIC COMPOUNDS (RARE EARTH, Y, Th, Co, AND U(VI) NITRATES). Singh, A. J. Bombay; Bombay Univ. (1970). 89p.

Thesis.

A description of systematic zone melting attempts (1) to separate rare earths and (2) to study the gadolinium break in the gradation in properties (here k, the distribution coefficient) along the series is given. Rare earth nitrates dissolved in molten salt mixtures were studied. Cations such as Y, Th, U(VI), and Co, usually associated or considered with rare earths, were also included in the study. The separation of rare earths by techniques based on fractional crystallization, ion-exchange, and solvent extraction was thoroughly investigated. Data on segregation behavior of individual rare earths, Y, Th, U(VI) and Co and their mixtures, and a series of zone melting curves, computed by Hamming's method, are given. (INIS)

2614 INFLUENCE OF TRICHLOROACETIC ACID IN THE EXTRACTION OF URANIUM FROM AQUEOUS SOLUTIONS WITH N-BUTANOL. Marcu, G.; Curtui, M. Stud. Univ. Babes-Bolyai, Ser. Chem.; 17: No. 2, 83-86(1972). (In Rumanian).

The influence of trichloroacetic acid (TCA) in the extraction of uranium from aqueous solution with n-butanol has been investigated. The relation between the repartition coefficient of uranium, the concentration of trichloroacetic acid, of uranium and the pH of the solutions suggests that the most likely formula of the extracted species is $[UO_2(OH)A]_0$. Since the extraction is favored by the presence of large quantities of trichloroacetic acid, it follows that the trichloroacetic acid plays also a role of outsalting agent. (auth)

2615 ION EXCHANGE STUDY OF URANIUM (U^{4+} AND UO^{2+}) COMPLEX SPECIES WITH Cl^- AS LIGAND. Bunus, F. T. (Institutul Fizica Atomica, Bucharest). J. Inorg. Nucl. Chem.; 36: No. 4, 917-920(Apr 1974).

An ion-exchange technique has been used to establish the complex species of U^{4+} and UO_2^{2+} and their stability constants in a Cl^- medium. An extensive study at different ionic strengths and cross linkings of the strong cation exchanger was made and the values of β_1 and β_2 established. Thermodynamic functions for the complexing were also obtained. (auth)

2616 SOLVENT EXTRACTION OF RARE-EARTH METAL IONS WITH THENOYLTRIFLUOROACETONE IN CARBON TETRACHLORIDE. Alstad, J.; Augustson, J. H.; Farbu, L. J. Inorg. Nucl. Chem.; 36: No. 4, 899-903(Apr 1974).

Extraction equilibrium constants for the formation of rare-earth ethenoyltrifluoroacetonates, $RE(TTA)_3$, have been determined for all rare earths including yttrium. The organic solvent was carbon tetrachloride containing 0.2 M HTTA initially and the aqueous phase was kept at constant ionic strength using 1 M$(H,Na)ClO_4$. The liquid-liquid distribution experiments were performed at (23 ± 2)°C, and the values of the extraction equilibrium constants, $K^*_{f,0}$, are given. The log $K^*_{f,0}$ values show the usual increase with atomic number, Z. Additionally, the trend shows a tetrad grouping and is compared with results of early and recent works from the literature. Yttrium is found to have a $K^*_{f,0}$ value intermediate to those of holmium and erbium. (auth)

2617 EXTRACTION OF Pa(V) BY A STERICALLY HINDERED PHOSPHINIC ACID FROM AN AQUEOUS CHLORIDE PHASE. Mason, G. W.; Lewey, S. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 36: No. 4, 911-915(Apr 1974).

The extraction behavior of Pa(V) in the liquid-liquid extraction system di-tertiary-butyl phosphinic acid, H[DtBP], in benzene versus aqueous chloride phases of various concentrations has been studied. The K for the extraction of Pa(V) into H[DtBP] from aqueous phases may be expressed mathematically as: 4F(HCl + NaCl): $K = K_5F^2/[H^+]$; 1F(HCl + NaCl): $K = K_5F^2/[H^+]$, high acid; $K = K_5F^2/[H^+]^3$, low acid; where K_5 is a constant characteristic of the system. A comparative study of the extraction behavior of Pa(V) into H[DtBP] and $(n\text{-}C_8H_{17}O)_2PO(OH)$, HDOP, from 1 F HCl, using several sets of conditions, revealed a striking difference in Pa(V) extraction behavior in the two systems. The variation of K of Pa(V) extraction into H[DTBP] by a factor of only 6.1% was within the limits of experimental error, whereas, the K varied by a factor of 22 in the HDOP system. The method reported in the literature for the preparation of H[DtBP] was modified to give a greatly improved yield; and a liquid-liquid partition purification procedure was devised and utilized to produce an ultimate product of the required purity. (auth)

2618 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. 18. Rate of Lanthanide (III) Extraction by di(2-ethylhexyl) Phosphoric Acid from Complexing Media. Kolarik, Z.; Koch, G.; Kuhn, W.

(Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 36: No. 4, 905-909(Apr 1974).

The rate of distribution was studied for the lanthanides(III) from La(III) to Eu(III) and of Y(III) between 0.3M di(2-ethylhexyl) phosphoric acid + 0.2M tributyl phosphate in n-dodecane and aqueous solutions of diethylenetriaminepentaacetic and lactic acids at pH 3. Both the forward and back extractions can be described as first order reactions. In extracting trace lanthanide(III) quantities the observed rate constant decreases with increasing atomic number from La to Eu. The effects of the temperature, transfer direction, and the concentrations of some components of the system were also studied. (auth)

2619 CHROMATOGRAPHIC SEPARATION OF SCANDIUM FROM VANADIUM(IV), ZIRCONIUM, AND HAFNIUM ON THE AB-16 ANION EXCHANGER MODIFIED BY TARTRATE-IONS. Brouchek, F. I.; Chirakadze, M. A. (Polytechnic Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 73: No. 2, 345-348 (Feb 1974). (In Russian).

The desorption of scandium, vanadium (IV), zirconium, and hafnium from the tartrate forms of the AB-16 and AB-17 anion exchangers with eluents of various nature and concentration was studied under dynamic conditions. Methods of chromatographic separation of the binary mixtures of scandium-vanadium (IV), scandium-zirconium, scandium-hafnium, and zirconium-hafnium by means of the tartrate form of the AB-16 anion exchangers, have been elaborated on the basis of the experimental data. (auth)

2620 EXTRACTION OF SOME ACIDS AND METAL PERCHLORATES OR NITRATES BY TRIBUTYL PHOSPHATE. Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 36: No. 2, 409-414(Feb 1974).

The extraction of perchloric, citric and nitric acids and Na(I), Sr(II), Eu(III), Ce(III), and Am(III) perchlorates or nitrates by tributyl phosphate in n-hexane has been studied. The extractability of perchlorate and nitrate forms has been compared in the case of Sr(II) and Eu(III). The nonideal behavior of tributyl phosphate in n-hexane has been investigated by vapor-pressure osmometric measurements and taken into account in discussing the composition of extracted complexes of all the above species. (auth)

2621 SYNERGISM IN THE EXTRACTION OF VANADIUM. Studies on the Extraction of Vanadium in the Presence of Salicylic Acid and Some Nitrogen Containing Organic Bases. Rao, V. P. R.; Sastry, V. V. R. (Andhra Univ. Waltair, India). J. Inorg. Nucl. Chem.; 36: No. 2, 415-420(Feb 1974).

There is marked synergism in the extraction of vanadium(IV) in the presence of both salicylic acid and nitrogen-containing organic bases (pyridine, picolines, quinoline, isoquinoline and o-phenanthroline). This synergistic enhancement is found to be due to the displacement of water from the coordination sphere by the base, or solvent in the case of alcohol. The extraction and formation constants and the effectiveness of the various bases as synergists have been compared. (auth)

2622 SYNERGISTIC SOLVENT EXTRACTION OF SOME 4f ELEMENTS FROM MOLTEN ALAKALI NITRATES AT 160°C. Targhetta, J.; Mesplede, J.; Porthault, M. (Univ., Lyon). J. Inorg. Nucl. Chem.; 36: No. 2, 445-450(Feb 1974).

Synergistic extraction of some rare earths elements Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Tm, and Yb in (Li-K)NO_3 eutectic at 160°C has been studied with the following mixtures: system I, thenoyltrifluoroacetone (HTTA) + ethylene bis(diphenylphosphine oxide) (2DPO) and system II, hexamethylphosphorotriamide (HMPT) + (2-DPO). These different reagents were diluted in a eutectic of polyphenyls. At the maximum of the synergistic effect, the mixed extracted species are respectively $Ln(TTA)_3(2\text{-}DPO)$ and $Ln(NO_3)_3(HMPT)(2\text{-}DPO)$ for all the lanthanides. With these two systems, the synergistic effect is small. But with the system I, an enrichment of the organic phase in the heavier lanthanide is possible. (auth)

2623 EXTRACTION OF CERTAIN ANIONIC ACTINIDE COMPLEXES FROM AQUEOUS SOLUTIONS BY LONG CHAIN ALKYL AMMONIUM COMPOUNDS. III. Uranium(VI)-thiocyanate System. Sato, T.; Kotani, S.; Good, M. L. (Shizuoka Univ., Hamamatsu, Japan). J. Inorg. Nucl. Chem.; 36: No. 2, 451-454(Feb 1974).

The extraction of the uranium(VI)-thiocyanato complex anionic species by a long-chain quaternary ammonium salt in benzene was investigated. Both the aqueous and organic phases were studied by spectrophotometry, and the latter has been studied using ir and NMR techniques. (auth)

2624 CRAIG DISTRIBUTION OF RARE EARTH NITRATES IN THE SYSTEM tri-n-BUTYL PHOSPHATE-NITRIC ACID. Purification of Lanthanum, Praseodymium, and Neodymium Oxides. Rossmanith, K. (Univ., Vienna). Monatsh. Chem.; 104: No. 2, 515-519(Mar 1973). (In German).

Preparative Craig distribution using an apparatus with 80 elements and withdrawal of upper phase, starting with enriched oxides (input 75 g), gave La_2O_3, Pr_6O_{11}, and Nd_2O_3 in purities from 99.9 to 99.99% (80-85% yield); up to 437 stages were effective. (auth)

2625 CRAIG DISTRIBUTION OF RARE EARTH NITRATES IN THE SYSTEM tri-n-BUTYL PHOSPHATE-NITRIC ACID. IV. Separation of Mixtures Using Apparatus with 120 and 160 Elements, or Preparation of Pure Samarium and Gadolinium. Rossmanith, K. (Univ., Vienna). Monatsh. Chem.; 104: No. 3, 758-766(May 1973). (In German).

Using an apparatus with 120 and 150 elements, the preparative Craig-distribution of yttrium-earth mixtures by withdrawal of the upper phase was examined on systematic variation of experimental conditions; these were characterized by the number of effective stages and the effective separation factors, which were demonstrated to show the tetrad effect. A much better separation could be achieved especially in the neighborhood of Sm, Eu, and Gd; up to 80% of the input (60g) was collected in a purity better than 90 or 99%, a significant part of La, Nd, and Sm-oxides was already better than 99.9%. Starting with products of a purity near 99%, Sm_2O_3 resulted in a purity of 99.9 to 99.99% and Gd_2O_3 better than 99.9% (yield 70 and 58% resp.). (auth)

2626 RECOVERY AND PURIFICATION OF PROMETHIUM. Wheelwright, E. J. (Battelle Pacific Northwest Labs., Richland, WA). pp 19-47 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Although some promethium was recovered and purified during the interim between 1945 and 1950, the total amount was limited to a few curies which were not of high purity, chemically or radiochemically. For experimental use, small amounts of promethium could be "borrowed" but not purchased. However, beginning in 1950, millicurie and then curie amounts became available for sale to licensees. Kilocurie quantities of high-purity ^{147}Pm were first produced in 1962 on a limited basis. In 1965 the promethium pilot plant at the Pacific Northwest Laboratory (PNL) was placed in operation and megacurie quantities (kilograms) of very high-purity ^{147}Pm became available. This chapter presents a brief review of the early production of ^{147}Pm, followed by a more detailed description of the development and utilization of advanced separations technology at Hanford. (auth)

2627 ANALYTICAL CHEMISTRY OF PROMETHIUM. Roberts, F. P. (Battelle Pacific Northwest Labs., Richland, WA). pp 191-211 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

In the development of the analytical chemistry of promethium, the primary emphasis has been placed on radiochemical procedures in which the promethium is separated from other activities and measured by beta or gamma counting techniques. There has been little incentive to develop other methods for quantitative analysis because the radiometric measurements are very sensitive and provide sufficient accuracy for most purposes. The most commonly used means of separating promethium from the interfering activities are ion exchange, solvent extraction, and carrier precipitation. Frequently, separation schemes will use more than one of these to achieve the degree of separation required. For the analysis of the beta-emitting ^{147}Pm, it is desirable to use carrier-free methods to minimize the errors caused by self-absorption in the beta counting. Promethium, like most of the rare earths, exhibits only the trivalent oxidation state in aqueous solutions and has little tendency to form polymeric species in mineral acids. Isotopic exchange in the absence of complexants is rapid, and no special treatment is required when gamma-emitting isotopes of promethium are used as tracers in the analysis of ^{147}Pm. This chapter presents a brief review of the radiochemical separation methods commonly used in the analysis of promethium and also describes the in-line methods used to control the cation-exchange process for large-scale purification of promethium. (auth)

2628 EXTRACTION OF LABELLED NONMETALLIC INCLUSIONS FROM HIGH-ALLOYED STEEL. Gebhardt, G. (Forschungsinstitut fuer NE-Metalle, Freiburg i. B.). Isotopenpraxis; 9: No. 10, 347-349(Oct 1973). (In German).

In order to separate inclusions from high-alloyed steel, the main components Fe, Ni, Cr and other metals are isolated by means of multi-stage liquid-liquid extraction using various

extraction agents. The inclusions remaining after this extraction in the aqueous phase evaporation residue with regard to most radionuclides without considerable self-absorption may be determined by making use of a large-area counter or some other suitable apparatus. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 5705.

Chemical and Physicochemical Properties

Refer also to abstracts 2469, 2786, 2808, 2844, 3083, 3084, 3835, 3839, 3840, 3868, 3894, 3934, 3937, 3947, and 5744.

2629 VALENCE-BOND CALCULATION OF THE SYMMETRIC DISSOCIATION OF BeH_2. Gallup, G. A. Norbeck, J. M. (Univ. of Nebraska, Lincoln). Chem. Phys. (Amsterdam); 2: No. 1, 19-26(Sep 1973).

VB calculations of the electronic structure of BeH_2 have been made at a number of internuclear distances. Several $^1\Sigma_g^+$ energy states for the symmetric dissociation are given and they all show minima in the energy curves. Only the ground state curve has a deep minimum. The structure is described and interpreted in terms of the atomic states which can be viewed as the component parts of the whole molecular wavefunction. The dissociation energy obtained in this calculation is 4.947 eV. (auth)

2630 CHEMISTRY OF URANYL VANADATES WITH TRIMETAVANADATE IONS AND LAYER STRUCTURE (UVANITE). I. Ionic Exchange with Inorganic Cations and Formation of Layer Solvates. Hilke, K. J.; Grosse-Brauckmann, U.; Lagaly, G.; Weiss, A. (Univ., Munich). Z. Naturforsch., 28b: No. 5-6, 239-245(May 1973). (In German).

The synthesis and properties of a uranyl vanadate with trimetavanadate ions are described. The compound has a layer structure with $[UO_2V_3O_9]^-$-layers of about 6.5 A thickness. The layers are identical with the U and V layers in natural uvanite. The cations M^{x+} between the $[UO_2V_3O_9]^-$-layers can be exchanged against inorganic and organic cations. The water molecules can be replaced by other solvent molecules (nitromethane, acetonitrile, dimethylsulfoxide, N-methylformamide, ethylene glycol, etc.) under formation of distinct layer solvates. Reversible dehydration of the hydrates between 100° and 500°C leads to regular displacements of the uvanite layers to each other. (GE)

2631 TRIPLE POINT OF THE FIRST MONOMOLECULAR LAYER OF KRYPTON ABSORBED ON THE CLEAVAGE FACE OF GRAPHITE. Influence of the Structure of this Surface on the Structure of the First Absorbed Layer of Rare Gases. Larher, Y. (CEN de Saclay, Gif-sur-Yvette, France). J. Chem. Soc., Faraday Trans., I; 70: 320-329(1974).

From adsorption isotherms of krypton on graphite measured between 79.24 and 88.46°K in the monolayer domain, a two-dimensional triple point of 84.8 ± 0.5°K was determined for this system. Thermodynamic analysis of these isotherms and of the isotherms of xenon on graphite measured by Thomy and Duval suggests that the surface structure plays a prominent role in the formation of dense monolayers on the (0001) face of graphite. To explain the striking difference of behavior of the two rare gases, two factors have to be taken into account; the height of potential barriers to translation and dimensional incompatibility between the lattices of the bulk adsorbates and of the (0001) face of graphite, the first "solid" layer appearing being in registry with the substrate. A single isotherm of argon on graphite measured at 68.78°K suggests that a more exhaustive study of the Ar + graphite system could be useful in establishing the relative importance of both factors. (auth)

2632 COMPARISON OF THE ION-EXCHANGE BEHAVIOUR OF ZIRCONIUM, THORIUM, VANADIUM, URANIUM, STANNIC, AND TITANIUM TUNGSTATES. Qureshi, M.; Gupta, J. P.; Sharma, V. (British Columbia Research Council, Vancouver). Talanta; 21: No. 1, 102-106(Jan 1974).

Zirconium, thorium, uranium, vanadium, stannic and titanium tungstates were prepared and their properties such as ion-exchange capacity, K_d values of metal ions, chemical composition and stability were compared. Titanium tungstate was found to be the most stable, and to have negligible capacity for tetravalent cations. (auth)

2633 REACTION OF NH_2Cl WITH TRANSITION METALS OF GROUP IV TO VI. Fritz, H. P.; Treptow, W. (Technische Univ., Munich). Z. Naturforsch., 28b: No. 9/10, 575-583(Oct 1973). (In German).

NH_2Cl and NH_4X react with transition metals of group IV to VI forming nitrides at relatively low temperatures. TiN-coated titanium is tested for its use in lead accumulators. (GE)

2634 REACTION OF SODIUM WITH WATER VAPOUR. Pulham, R. J.; Simm, P. A. (Univ. of Nottingham, Eng.). pp 1-4 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Water vapor reacts rapidly with liquid sodium at 300 to 450°C liberating half of its volume of hydrogen which is subsequently absorbed at a relatively slower rate. The equilibrium pressures of hydrogen show that sodium hydride, oxide and hydroxide are formed, which dissolve in the metal. The proportions of these species depend upon the temperature and amount of water added. The precipitation of these entities from solution can be followed by changes in electrical resistivity, and the order of precipitation is governed by the ternary sodium-hydrogen-oxygen phase diagram. (auth)

2635 REACTION OF HYDROGEN WITH SOLUTIONS OF METALS IN LIQUID SODIUM. Hobdell. M. R.; Whittingham, A. C. (Central Electricity Generating Board, Berkeley, Eng.). pp 5-12 of Liquid Alkali Metals. London British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It had been previously shown that in the temperature range 373 to 473°K a solution of 5 at.% Ba in Na was considerably more reactive towards H_2 than was Na alone, although in both cases the reaction rate was directly proportional to the H_2 pressure and first-order kinetics were shown. This suggested that measurement of first-order rate constants as a function of liquid metal composition might provide a convenient technique for investigating liquid metal reactivity, using H_2 as a reactivity monitor. The reactivity of liquid Na towards H_2 was studied as a function of solute metal concentration, temperature (393 to 573°K), and H_2 pressure (0 to 35 k Nm^{-2}). The overall reaction is $H_{2(gas)} + 2e_{(from\ liquid\ metal)} \geq 2H^-$ (hydride). The metal solutes selected for study had widely differing electronic structures so that modifications to the liquid Na conduction band, and hence the reactivity, would be as wide ranging as possible; they also possessed measurable solubility in liquid Na at the temperatures involved, enabling reactivity to be conveniently studied as a function of solute concentration. The metals selected were Ba, Li, Hg, Ca, and Pd, and the experimental procedure and results are described in detail. It was concluded that the simple technique of measuring H_2 uptake by solutions of metals in liquid Na is useful in investigations into their nature. (UK)

2636 REACTIONS OF HYDROCARBONS AT THE SURFACE OF LIQUID SODIUM. Addison, C. C.; Hobdell, M. R.; Parry, G.; Pulham, J. (Univ. of Nottingham, Eng.). pp 13-14 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Whether or not a simple hydrocarbon molecule will react at the surface of liquid sodium depends on several factors, of which the strength of chemisorption is probably most important. Thus methylacetylene (propyne) and acetylene react at 100° to 200°C, but ethylene and ethane do not react. However, ethylene does react at the surface of a sodium–potassium alloy. The course and mechanism of the reactions are discussed. (auth)

2637 PRECIPITATION OF BARIUM NITRIDE FROM LIQUID SODIUM. Hubberstey, P. (Univ. of Nottingham, Eng.). pp 15-19 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The chemistry of the sodium-rich sodium–barium–nitrogen ternary system (minimum concentration 90 at. % Na) is interpreted from the results of kinetic, solubility, and resistometric experiments. Thus the reaction of nitrogen with solutions of barium in liquid sodium is explained in terms of a sequence involving the initial formation of a barium–nitrogen species, soluble in the liquid metal solution, followed by the consecutive formation of the solid products Ba_2N and Ba_3N_2. The variation of the solubility of the barium–nitrogen species with both temperature and initial concentration of the sodium–barium solution is discussed in terms of the sodium–barium–nitrogen ternary phase diagram. (auth)

2638 ACTION OF SODIUM AND POTASSIUM ON THE DIOXIDES MeO_2 AND OXY-SALTS M_2MeO_4 (M = Na,K; Me = Mo,W). Kessler, H. (Ecole Superieure de Chemie, Mulhouse, France); Hatterer, A.; Ringenbach, C. pp 21-23 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The reaction of sodium and potassium vapors with the dioxides MeO_2 (Me = Mo,W) and the oxy-salts M_2MeO_4 (M = Na,K) was studied at 300 to 600°C and at vapor pressures of 0.01 to 0.1 Torr. The compounds $NaMoO_3$, Na_2MeO_4, and $K_4Me_2O_5$ were formed. Their chemical and physical properties are described. (auth)

2639 REVIEW OF THE CHEMISTRY OF LIQUID LITHIUM AS A BLANKET MATERIAL FOR THERMONUCLEAR POWER REACTORS. Long, G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 31-35 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

From the nuclear point of view liquid lithium provides an eminently suitable material for the tritium breeder blanket of a thermonuclear reactor. In this review are highlighted some of the important differences in the use of a liquid metal as a fusion reactor breeder blanket and as a fast reactor coolant. These arise partly from differences in chemical behavior of the two alkali metals involved and partly from the specific requirements of the fission and fusion systems. (auth)

2640 SOLVATION IN LIQUID ALKALI METALS. Thompson, R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 47-50 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The solubility of non-metals in liquid alkali metals is discussed. Assuming the solutes are present as ionic species solvation energies are calculated using a first-order approximation screened potential model and a quasi-lattice model. The calculated values are compared with experimental data. Reasonable agreement is obtained for calculated and experimental values except for small ions, using the screened potential model. (auth)

2641 DEVELOPMENT AND USE OF ELECTROCHEMICAL TECHNIQUES FOR STUDYING CARBON BEHAVIOUR IN LIQUID ALKALI METAL SYSTEMS. Hobdell, M. R.; Gwyther, J. R. (Central Electricity Generating Board, Berkeley, Eng.). pp 127-132 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is stated that lack of progress in both technological and academic aspects of carbon behavior in liquid Na and other liquid alkali metals reflects the absence of suitable proven techniques for the study. Carbon chemical potential, or carbon activity, is considered to be a more useful parameter than concentration from both technological and academic viewpoints, and electrochemical concentration cells provide, in principle, excellent means for measuring directly this potential. The studies described are concerned with the development and use of such devices. A brief account is given of earlier work in this field, followed by a description of experimental work conducted with a view to testing rigorously the basic features of electrochemical carbon cells. Only molten carbonate electrolytes are considered, and the cell investigated is represented by: Environment/Fe membrane/ $Na_2CO_3-Li_2CO_3$ electrolyte/Fe · Fe_3C. Results demonstrated that the cell EMF is a direct measure of carbon activity, and confirmed the suitability of the carbonate electrolyte and the use of α-iron as an inert carbon permeable membrane. Experimental studies were concerned with (1) variation of cell EMF with carbon activity in a sodium environment, (2) carbon activity in a gaseous environment, (3) with carbonate activity in the electrolyte at constant electrode carbon activities, and (4) variation of cell voltage with current. Work in progress is indicated. (UK)

2642 BIOLOGICAL PROBES. I. Carbon-6-Labeled Nicotinamide. Bryson, T. A.; Wisowaty, J. C.; Dunlap, R. B.; Fisher, R. R.; Ellis, P. D. (Univ. of South Carolina, Columbia). J. Org. Chem.; 39: No. 8, 1158-1160(19 Apr 1974).

An efficient method was developed for preparing gram quantities of specifically labeled nicotinamide containing ^{13}C at the C-6 position. The incorporation of this base into the coenzyme NAD^+ using biosynthetic techniques can be readily accomplished. (DHM)

2643 HIGHLY RADIATION-SENSITIVE TELOMERIZED POLYESTERS. D'Alelio, G. F. (to PPG Industries Inc.). Canadian Patent 916,631. 12 Dec 1972.

Oligomers or polymers with hydroxyl groups are reacted with glycidyl acrylate or glycidyl methacrylate to give radiation-sensitive telomers which are the subject of the invention. The initial oligomers or polymers may be polyesters made with an excess of glycol, polyalkylene oxides, or the like. The extra hydroxyl group produced in the reaction of glycidyl ester may be reacted with acrylic anhydride or other reagents. The telomers are useful for crosslinking unsaturated alkyd resins. The curing is effected by means of radiation, preferably accelerated electrons. (NDH)

2644 PROCESS FOR THE PRODUCTION OF CROSSLINKED INSOLUBLE POLYMERS FORMING GLYCIDYL ACRYLATES. D'Alelio, G. F. (to PPG Industries Inc.). Canadian Patent 916,630. 12 Dec 1972.

Polymers crosslinkable by radiation (especially accelerated electrons) are prepared by reacting polyacrylic acid with glycidyl acrylate and then (optionally) reacting the hydroxyl groups formed with acrylic anhydride or any of a number of other reagents. Methacrylates may generally be substituted for acrylates. The crosslinkable polymers may be blended with conventional unsaturated alkyd resins to render them radiation-curable. Preferably, no aromatic groups are present, since they act as sinks for radiation-produced radicals. (CA)

2645 STRUCTURE OF COMPLEXES OF THE ION RADICAL O_2^- WITH METAL IONS OF GROUP IV OF THE PERIODIC SYSTEM. Berdnikov, V. M.; Schastnev, P. V.; Merkulov, A. A.; Balaev, A. V.; Bazhin, N. M.; Gatilov, Yu. V. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). J. Struct. Chem. (USSR) (Engl. Transl.); 14: No. 4, 589-595(1973).

Translated from Zh. Strukt. Khim.; 14: No. 4, 634-641(1973).

The ESR spectra of complexes of the ion radical O_2^- with Ti(IV), Zr(IV), Hf(IV), and Th(IV) ions in the solid phase at liquid-nitrogen temperature were analyzed. A conclusion was drawn on the most probable structure of the complex and the most probable type of coordination of the O_2^- ion-radical. Results of the theoretical calculation agree with the obtained conclusions. (auth)

2646 DETERMINATION OF TOTAL MIGRATION FROM PLASTICS-PACKAGING MATERIALS INTO EDIBLE FATS USING A ^{14}C-LABELLED FAT SIMULANT. Figge, K. (Unilever Forschungs GmbH, Hamburg). Food Cosmet. Toxicol.; 11: No. 6, 963-974(Dec 1973).

In the future, total migration may prove to be of great importance in the assessment of the physiological acceptability of new packaging materials, provided a practicable, reliable and sensitive method of determination is available. A suitable radiotracer method has been developed using a ^{14}C-labelled standard triglyceride mixture, known as fat simulant HB 307-[^{14}C]. On the basis of the principle proposed by the Bureaux Internationaux Techniques des Matieres Plastiques (BITMP), the sample of the packaging material is weighed before and after storage in fat simulant HB 307-[^{14}C]. The content of test fat remaining in and on the stored sample is determined by radio-analysis. The total migrate then equals the difference between (a) the weight of the sample before storage in the test fat and (b) the weight after storage less the weight of the fat absorbed by the sample during that storage. This method was tested with specimens of plasticized PVC, LD-polyethylene, polystyrene and polyvinylidene chloride. The coefficient of variation of the single results about the mean showed a marked dependence on the amount of total migrate, the coefficients associated with 1, 6, and 12 mg total migrate/dm^2 surface of packaging material being 9, 2, and 0.6%, respectively. (auth)

2647 REPRESENTATION OF CHEMICAL ELEMENTS AND CHEMICAL REACTIONS. Silver, G. L. (Mound Lab., Miamisburg, OH). J. Inorg. Nucl. Chem.; 36: No. 4, 939-941(Apr 1974).

It is stated that it would be convenient when considering the chemistries of the elements to have available an equation for each element so that, by specifying conditions exactly, the complete distribution of the element in all of its possible forms could be readily and speedily calculated. As an example a description is given of plutonium in solution by means of a single polynomial equation. It is suggested that the description of chemical reactions by polynomial equations may proceed by a similar path, and as an example the iron–cerium reaction is described. (UK)

Isotope Effects

Refer also to abstracts 2543, 2750, and 2751.

2648 (COO-2217-4) OXIDATION OF IODIDE ION BY SINGLET OXYGEN. Bryant, F. D.; Kepka, A. G.; Grossweiner, L. I. (Illinois Inst. of Tech., Chicago (USA). Dept. of Physics).

[nd]. Contract AT(11-1)-2217. 5p. (CONF-740607-1). Dep. NTIS $4.00.

From eleventh informal conference on photochemistry; Nashville, Tennessee, USA (16 Jun 1974).

Analysis of preliminary experiments on iodide ion and new experiments using laser flash photolysis are reported. The quantum yields for photodynamic oxidation of air-saturated iodide ion are approximately 10 times higher in D_2O than in H_2O. (LK)

2649 STARK EFFECTS ON THE LOWEST $^1B_{1g}(n\pi^*)$ STATE OF p-BENZOQUINONE. Veenvliet, H.; Wiersma, D. A. (Univ., Groningen, Netherlands). Chem. Phys. (Amsterdam); 2: No. 1. 69-75(Sep 1973).

Stark effects on the optical absorption spectrum of the lowest singlet state in p-benzoquinone (PBQ)-h_4 and -d_4 single crystals at 1.8°K are reported. The singlet origin components in PBQ-h_4 at 20057.8 cm^{-1} and 20061.3 cm^{-1} are shown to be states of opposite parity. The Stark experiments yield a transition moment between these levels of 2.2 ± 0.1D ($E_b = 1.6E_{eff}$) for both PBQ-h_4 and -d_4. Polarization experiments on the lower energy origin expose its magnetic dipole character and this state is assigned as a state of B_{1g}-total symmetry. A sizeable deuteration effect on the oscillator strength of this B_{1g} origin is also reported and discussed. Vibronic lines up to 1000 cm^{-1} from the origin lines also have been studied in external electric fields and these results are reported as well. A qualitative discussion of these results is given on the basis of a double minimum potential model for the lower $^1B_{1g}(n\pi^*)$ state. Arguments pro and contra this model are presented and the alternative of two close lying $^1B_{1g}(n\pi^*)$ and $^1A_u(n\pi^*)$ states is explored as well. (auth)

2650 VIBRONIC INTENSITY BORROWING AND THE ISOTOPE DEPENDENCE OF VIBRONIC STRUCTURE. Orr, G.; Small, G. J. (Iowa State Univ., Ames). Chem. Phys. (Amsterdam); 2: No. 1, 60-68(Sep 1973).

In recent years it has become clear that the conventional Herzberg–Teller theory is not capable of explaining the breakdown in intensity mirror symmetry between the "forbidden" vibronic structure in absorption and fluorescence spectra of many polyatomic molecules. Furthermore, in a number of systems the isotope dependence of vibronic intensities predicted by the Herzberg–Teller theory is not obeyed. A theory of vibronic structure is presented which includes the so-called Born–Oppenheimer vibronic coupling and the Duschinsky and isotope dynamic mixing adiabatic corrections to the conventional Herzberg–Teller theory. The results of illustration calculations for a three-mode system are presented and discussed. auth)

2651 [2.2] PARACYCLOPHANE SYSTEM OPTICAL ACTIVITY. III. Theory for Isotopic Substitution Chirality. Hassloch, M. A.; Nugent, M. J.; Weigang, O. E. Jr. (Tulane Univ., New Orleans). J. Amer. Chem. Soc.; 96: No. 8, 2619-2620(17 Apr 1974).

A vibronic coupling theory is outlined for the source of rotatory strength that occurs in the deuterium substituted [2.2] paracyclophane system. (LK)

2652 [2.2] PARACYCLOPHANE SYSTEM OPTICAL ACTIVITY. IV. Circular Dichroism of (—)-(S)-4-Deuterio [2.2] Paracyclophane. Hoffman, P. H.; Ong, E. C.; Weigang, O. E. Jr.; Nugent, M. J. (Tulane Univ., New Orleans). J. Amer. Chem. Soc.; 96: No. 8, 2620-2621(17 Apr 1974).

The first ultraviolet transition circular dichroism arising from deuterium-hydrogen chirality is reported. The transition was observed for a system which has a broadly verified model for the origin of transition rotatory strength. (LK)

2653 HYDROLYSIS OF SUBSTITUTED TRIFLUOROACETANILIDES. Nucleophilic Catalysis by Imidazole. Stauffer, C. E. (Procter and Gamble Co., Cincinnati). J. Amer. Chem. Soc.; 96: No. 8, 2489-2493(17 Apr 1974).

The hydrolysis of a number of ring-substituted trifluoroacetanilides is markedly accelerated by imidazole buffer. It is found that this is due strictly to nucleophilic attack by imidazole base, with no general acid or general base catalysis observed. Spectrophotometric evidence is presented for the formation of a tetrahedral intermediate, attributed to addition of imidazole to the carbonyl carbon of trifluoroacetanilide. Specific acid protonation of the tetrahedral intermediate does take place during the rate-limiting breakdown to give hydrolysis products and an isotope effect of 4.3. A plot of log κ_s (rate constant for the breakdown step) vs. σ for the ring substituents showed two segments. When electron-donating substituents were present ($\sigma < 0$) ρ, the slope of the plot was +0.8, while the substituents were electron attracting ($\sigma > 0$) ρ was +2.1. This difference is interpreted in terms of a change in the relative importance in the transition state of proton donation to the anilide –N< as compared to the breaking of the ≥CN^+≤ bond. Comparison of the results obtained with observations on catalysis of amide hydrolysis by α-chymotrypsin leads to the conclusion that the hydrolysis of trifluoroacetanilides in the presence of imidazole is not a good model for the enzymatic reaction. (auth)

2654 MECHANISMS OF ACYL GROUP TRANSFER FROM A TETRAHEDRAL INTERMEDIATE. Rogers, G. A.; Bruice, C. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 8, 2481-2488(17 Apr 1974).

The first isolation and unequivocal characterization of a tetrahedral intermediate in an acetyl transfer reaction are reported. The structure elucidation was achieved via observations involving the compounds' ir and nmr spectra, borohydride reduction product, and intra- and intermolecular reactions in solution. In H_2O at all pH's studied (0–12.4), the tetrahedral intermediate (I) rearranges quantitatively to the phenyl acetate (III) which subsequently hydrolyzes to the phenol (II). The proposed mechanism of intramolecular acetyl group transfer to the phenol group (I — III) is one involving the intermediate formation of an N-acetylimidazole. In contrast, intermolecular attack at the carbonyl carbon of the acylal-type tetrahedral intermediate can be shown to account for the rate acceleration of acetyl group transfer in the presence of nitrogen bases. (auth)

2655 MEDIUM EFFECTS ON HEAVY-ATOM KINETIC ISOTOPE EFFECTS. III. Structured Medium Model Applied to Complex Formation via Mass Point Attachment and Coupling. Keller, J. H.; Yankwich, P. E. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 96: No. 8, 2303-2314(17 Apr 1974).

A structured medium model (SMM) for reactant-medium interactions is defined and applied to calculation of heavy-atom kinetic isotope effects in the reaction of a three-particle molecule as influenced by attachment (and coupling) of one and two mass points. The results for this simplest model of complex formation with uni- and bidentate ligands are compared with those obtained previously with a cell model (CMM) treatment of reactant-medium interactions, several different flat-barrier reaction coordinates being tested. A number of different methods were tried for handling the problem of redundant internal coordinate sets; such redundancies are commonplace in intramolecular hydrogen bonding and whenever cycles are produced by bonds among particles. SMM effects on the temperature-dependent factor in an isotopic rate constant ratio are larger at comparable force constant levels than those obtained via CMM. Interactions sufficiently weak that a reactant-ligand complex forms without alteration of the reaction coordinate or diagonal force field of the reagent yield isotope effects within the framework of SMM which could be measured in careful comparison experiments, while those predicted by CMM would be undetectable. The SMM generates substantial effects on the temperature-independent factor in the isotopic rate constant ratio which have no counterpart in CMM. Comparison of related intermolecular and intramolecular kinetic isotope effects should be especially useful in estimating actual complexing and/or medium effects and in discovering the conditions under which CMM or SMM is the better model. (auth)

2656 EFFECT OF APROTIC SOLVENTS ON THE KINETIC ISOTOPE EFFECT IN THE HYDROGEN EXCHANGE OF DURENE AND 2,5-DI-TERT-BUTYLTHIOPHENE WITH TRIFLUOROACETIC ACID. Serebryanskaya, A. I.; Yakushin, F. S.; Maksimova, P. A.; Shatenshtein, A. I. (Physical-Chemical Inst., Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 14: No. 4, 754-757(1973).

Translated from Kinet. Katal.; 14: No. 4, 866-869(1973).

The magnitudes of the kinetic isotope effect (KIE) were determined for the deuterium and tritium exchange of durene and 2,5-di-tert-butylthiophene with CF_3COOH and its equimolar solutions in n-hexane, liquid sulfur dioxide, and sulfolan, and also at different concentrations of the acid in n-hexane. The values of k_D/k_T varied between 1.1 and 1.7, the lowest KIE value being obtained in the electron-donating solvent sulfolan. There is no correlation between k_D/k_T and the CF_3COOH concentration in n-hexane. The results are compared with literature data obtained in aqueous solutions of acids. (auth)

2657 CHEMISTRY OF METALATED HETEROCYCLES. Site of Metalation of 2-Methyl-4-Substituted 1,3-Thiazoles. Electronic, Steric, and Isotope Effects. Knaus, G.; Meyers, A. I. (Colorado State Univ., Fort Collins). J. Org. Chem.; 39: No. 9, 1192-1195(3 May 1974).

Metalation of 2-methyl-4-aryl-1,3-thiazoles proceeds predominantly at the C-5 position, whereas metalation of the 4-alkyl derivative occurs at the 2-methyl group. It is shown that the anions generated at –78°C are the result of the respective kinetic acidities of these positions. Furthermore, at elevated temperatures, the thermodynamic acidities prevail, producing the lithio methyl anions regardless of the nature of the 4 substituent. An apparent primary kinetic isotope effect for the

C-5 ring proton was determined that agrees well with the isotope effect for other heterocyclic protons. (auth)

2658 DECOMPOSITION OF PYRIDINE-2- AND -4-DIAZOTATES. Bunton, C. A.; Minch, M. J.; Wolfe, B. B. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 10, 3267-3275(15 May 1974).

The pH dependence of the decomposition of pyridine-4-diazotate is complex. At pH > 6, there is second-order dependence on hydroxide ion concentration due to equilibria between pyridine-4-diazonium ion, -4-diazohydroxide, and -4-diazotate. The rate is independent of pH between 4 and 6, and the rate constants for formation of pyridine-4-diazonium ion, its decomposition to 4-pyridone, and its back reaction with hydroxide were measured. There is a rate minimum at pH 1.5 due to formation of protonated pyridine-4-diazohydroxide, with an acid-catalyzed decomposition in more acid solution. The pK values for the acid dissociations of protonated pyridine-4-diazohydroxide to diazohydroxide and then to diazotate are 4.15 and 6.9, respectively. The products of the acid-catalyzed decomposition depend upon the medium. The normal product is 4-pyridone, but there is considerable denitrosation in more concentrated acid to give 4-aminopyridine, and in addition an intermediate can be trapped by chloride ion giving 4-chloropyridine or by ascorbic acid giving 4-aminopyridine, but without affecting the over-all rate. Kinetic solvent deuterium isotope effects are consistent with the proposed mechanisms. The 4-diazonium ion can be trapped by phenoxide ions, and the rate constants were estimated, and with the anion of 2-methyl-1-naphthol they approach diffusion control. The decomposition of pyridine-2-diazotate has a pH dependence which can be explained in terms of equilibrium protonation followed by decomposition to 2-pyridone. (auth)

2659 CHLORINE KINETIC ISOTOPE EFFECTS IN NUCLEOPHILIC SUBSTITUTION REACTIONS. Support for the Ion Pairs Mechanism in the Reactions of P-Methoxybenzyl Chloride in 70% Aqueous Acetone. Graczyk, D. G.; Taylor, J. W. (Univ. of Wisconsin, Madison). J. Amer. Chem. Soc.; 96: No. 10, 3255-3261 (15 May 1974).

The possibility that the variation of the chlorine leaving group kinetic isotope effects with nucleophile concentration might serve to detect the intervention of ion pairs was examined for the competitive reactions of p-methoxybenzyl chloride with solvent water and added sodium azide in 70% aqueous acetone at 20°. The observed isotope effect value increases more than 30% (1.00786 ± 0.00010 to 1.01049 ± 0.00025) as the azide concentration is varied from zero to approximately 0.25 *M*. It is demonstrated that this observation is consistent with the ion pairs mechanism but not with simultaneous SN1 and SN2 processes. The solvolysis reaction carried out in the presence of 0.200 *M* potassium nitrate is shown to be complicated by nucleophilic participation by the nitrate anion. The increased isotope effect observed with the nitrate nucleophile also supports the ion pairs hypothesis for the p-methoxybenzyl chloride substrate. (auth)

2660 NITROGEN ISOTOPE EFFECTS ON THE PAPAIN-CATALYZED HYDROLYSIS OF N-BENZOYL-L-ARGININAMIDE. O'Leary, M. H.; Urberg, M.; Young, A. P. (Univ. of Wisconsin, Madison). Biochemistry; 13: No. 10, 2077-2081(7 May 1974).

The papain-catalyzed hydrolysis of N-benzoyl-L-argininamide shows nitrogen isotope effects (k^{14}/k^{15}) and 25°C of 1.021 at pH 8.0, 1.024 at pH 6.0, and 1.023 pH 4.0. These isotope effects are much larger than those observed in the chymotrypsin-catalyzed hydrolysis of N-acetyl-L-tryptophanamide [O'Leary, M. H., and Kluetz, M. D. (1972), J. Amer. Chem. Soc. 94, 3585] and are near the upper limit of nitrogen isotope effects which are observed in reactions in which a bond is broken to an isotopic nitrogen atom. The isotope effects are interpreted in terms of the partitioning of a tetrahedral intermediate. In the case of chymotrypsin, the tetrahedral intermediate partitions rather equally between return to starting materials and loss of ammonia, whereas in the case of papain, the intermediate returns to starting material much more frequently than it decomposes to acyl-enzyme, and carbon–nitrogen bond breaking is entirely rate determining. This interpretation is consistent with the expected properties of the oxygen and sulfur nucleophiles present at the active sites of the two enzymes. (auth)

2661 VIBRATIONAL SPECTRA AND STRUCTURE OF ESTERS. I. Infrared and Raman Spectra of CH_3COOCH_3, CH_3COOCD_3, CD_3COOCH_3, AND CD_3COOCD_3. George, W. O.; Houston, T. E.; Harris, W. C. (Kingston Polytechnic, Kingston upon Thames, Eng.). Spectrochim. Acta, Part A; 30A: No. 4, 1035-1057(Apr 1974).

The infrared spectra of gaseous, liquid and solid methyl acetate and its deuterium derivatives have been investigated from 4000 to 200 cm^{-1}. The absorption spectrum of the crystalline state of each isotope has also been measured down to 33 cm^{-1}, but the methyl torsional modes were not resolved. Raman spectra of the gaseous, liquid and solid states were obtained between 100 and 4000 cm^{-1}. It is concluded that methyl acetate is present as a single molecular conformation in the temperature range studied since there is a one to one correspondence between the infrared and Raman transitions measured at ambient and liquid nitrogen temperatures. An assignment of the 27 normal modes, based upon relative band intensities, isotopic shift ratios and group frequency correlations is presented. (auth)

2662 ION MOLECULE REACTION IN NITROGEN–HYDROGEN SYSTEM AND ITS EFFECT ON MASS SPECTROMETRIC ANALYSIS OF ^{15}N. Joseph, K. P.; Paul, S. D. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Chem.; 11: No. 10, 1059-1060(Oct 1973).

The ion-molecule reaction in nitrogen–hydrogen system was investigated to find out the formation of N_2H^+ and N_2D^+ ions at different pressures of hydrogen and deuterium respectively. A method is suggested for the accurate determination of ^{15}N abundance even if hydrogen is present in the sample in small amounts. (auth)

2663 RAMAN SPECTRA OF CRYSTALLINE ETHYLENEDIAMMONIUM CHLORIDE AND ITS NITROGEN DEUTERATED ANALOG. McLachlan, R. D. (Dow Chemical Co., Midland, MI). Spectrochim. Acta, Part A; 30A: No. 4, 985-991(Apr 1974).

Polarized single crystal Raman spectra of ethylenediammonium chloride and ethylenediammonium chloride-d_4 have been measured and assignments of the Raman active vibrations of these crystals are proposed. (auth)

2664 INVESTIGATION OF SOME GAS PHASE REACTIONS OF HYDROGEN ATOMS WITH UNSATURATED HYDROCARBONS AND SOME ISOTOPIC AND MIXED ISOTOPIC VARIATIONS BY MASS SPECTROMETRIC DETECTION IN A DISCHARGE FLOW SYSTEM: ABSOLUTE RATE DETERMINATIONS AND MECHANISM INVESTIGATIONS. Keil, D. G. Pittsburgh; Carnegie-Mellon Univ. (1973). 227p. University Microfilms Order No. 73-22,570. Thesis (Ph. D.).

A discharge flow reactor coupled to a time-of-flight mass spectrometer has been used in the investigation of the room temperature gas phase reactions of hydrogen atoms with various unsaturated hydrocarbons. Helium was used as the carrier gas for all the reactions studied, at total pressures in the approximate range of one to five torr. The following reactions were studied mechanistically with product-time profiles, and kinetically in both hydrogen atom-lean and hydrogen atom-rich conditions, where possible: $H + C_2H_4$, $D + C_2H_4$, $H + C_2H_2$, $H + C_2D_2$, $D + C_2H_2$ and $D + C_2D_2$. The rate constants for all these reactions except $D + C_2H_2$, $k = (12.2 \pm 1.2) \times 10^{-14}$ cm^3 $molecule^{-1}$ sec^{-1}, have been found to be pressure-dependent over the pressure range investigated, and the pressure dependence of each reaction has been determined. The major observed products of the $H + C_2H_4$ reaction are CH_3, CH_4 and C_2H_6, while the $H + C_2H_2$ reaction is characterized purely by the production of molecular hydrogen. The mixed isotope reactions also involve extensive isotopic mixing in reactants and products which has provided extensive mechanistic information. With the use of product profiles, the rate constants for the reactions $H + C_2HD$ (pressure-dependent) and $D + C_2HD$ (pressure-independent–$k = (6.8 \pm 1.4) \times 10^{-14}$ cm^3 $molecule^{-1}$ sec^{-1}) in hydrogen atom-rich conditions have been determined. The rate constants for the reactions of hydrogen atoms with the higher olefins (C_3–C_5) have been determined by olefin depletion in hydrogen atom-rich conditions. No isotope studies of these reactions have been made. The rate constant for the $H + C_2H_4$ reaction exhibits a small pressure dependence from one torr ($k = 6.6 \pm 0.6 \times 10^{-13}$ cm^3 $molecule^{-1}$ sec^{-1}) to five torr ($k = 8.0 \pm 0.8 \times 10^{-13}$ cm^3 $molecule^{-1}$ sec^{-1}). The rate constants for the other olefins that have been determined are: $(11.3 \pm 0.8) \times 10^{-13}$ (1-butene); $(6.4 \pm 0.5) \times 10^{-13}$ (cis-2-butene); $(7.1 \pm 0.4) \times 10^{-13}$ (trans-2-butene); $(10.6 \pm 0.8) \times 10^{-13}$ (1-pentene). (Diss. Abstr. Int., B)

2665 SOLVENT ISOTOPE EFFECTS OF SULFONEPHTHALEIN INDICATOR DIANION–H^+ RECOMBINATION KINETICS. Lentz, D. J.; Hutchins, J. E. C.; Eyring, E. M. (Univ. of Utah, Salt Lake City). J. Phys. Chem.; 78: No. 10, 1021-1023(9 May 1974).

Acid–base recombination rates for Bromocresol Green (BCG), Bromocresol Purple (BCP), and Chlorophenol Red (CPR) were determined in H_2O and D_2O at 25°C ($I \approx 0$) by the spectrophotometric electric field jump relaxation technique. For the reaction $H^+ + In^{2-} \rightarrow HIn^-$ in water the specific rates (in units of 10^{10} M^{-1} sec^{-1}) are 7.71 ± 0.97, 7.77 ± 0.43, and 9.44 ± 0.48 for BCG, BCP, and CPR, respectively. The corresponding specific rates in deu-

terium oxide for the reaction $D^+ + In^{2-} \rightarrow DIn^-$ are 5.16 ± 0.50, 6.36 ± 1.48, and 6.14 ± 0.81, respectively. The average solvent deuterium oxide kinetic isotope effect on this reaction is therefore ~1.4 in good agreement with a theoretical value of ~1.3 derivable from Debye's phenomenological equation for the specific rate of a diffusion-controlled ion recombination. (auth)

2666 KINETICS OF PROTON TRANSFER REACTIONS OF CARBON ACIDS. 4. Primary Deuterium Isotope Effect in the Reaction of Di-(4-Nitrophenyl)-Methane-d_2 with T-Butoxide. Kim, J. H.; Leffek, K. T. (Dalhousie Univ., Halifax, N.S.). Can. J. Phys.; 52: No. 4, 592-596(15 Feb 1974).

The primary deuterium isotope effect was measured for the proton transfer reaction from di-(4-nitrophenyl)methane to t-butoxide ion in a solvent consisting of 10% v/v toluene in t-butanol at a series of temperatures between 20 and 45°C. The isotopic rate ratio, k_H/k_D, is 7.3 at 25°C. The activation parameters showed an enthalpy of activation difference ($\Delta H_D^{\ddagger} - \Delta H_H^{\ddagger}$) of only ca. ½ kcal mol^{-1} and an entropy isotope effect ($\Delta S_D^{\ddagger} - \Delta S_H^{\ddagger}$) of −2.4 cal mol^{-1} deg^{-1}. The latter indicates, according to the theory of Bell, that tunnelling of the proton through the energy barrier is unimportant in this reaction. This result is compared to other reactions in the literature, in which tunnelling has been postulated to occur. (auth)

2667 MEAN AMPLITUDES FOR THE IN-PLANE VIBRATIONS OF VARIOUS LINKAGES IN PROPIONAMIDE, N-METHYLPROPIONAMIDE AND THIOPROPIONAMIDE AND OF THEIR DEUTERATED SPECIES. Venkata Ramiah, K. (Osmania Univ., Hyderabad, India); Usha Bai, P.; Venkata Chalapathi, V. Indian J. Pure Appl. Phys.; 11: No. 8, 552-553(Aug 1973).

The mean amplitude of vibration of various linkages in three tertiary amides, viz. propionamide, thiopropionamide and N-methylpropionamide and in their deuterated species was calculated using the L matrix. The variation of the mean amplitudes of vibration on deuteration was explained on the valence character of the bonds between the atoms. (auth)

2668 RAMAN STUDIES OF REORIENTATION OF CARBON TETRACHLORIDE MOLECULES IN THE LIQUID AND PLASTIC SOLID PHASES. Sunder, S.; McClung, R. E. D. (Univ. of Alberta, Edmonton). Chem. Phys. (Amsterdam); 2: No. 4, 467-472(Dec 1973).

The contours of the ν_2 and ν_4 bands of carbon tetrachloride have been studied over the temperature range 240−373°K. Vibrational contributions to the spectral band shapes were estimated from the width of the totally symmetric ν_1 band, and the presence of the different isotopic CCl_4 molecules with different vibration frequencies was taken into account. Reorientational and angular momentum correlation times which characterize the rotational motions of the molecules in the liquid and plastic phases were obtained by comparing the corrected Fourier transforms of the ν_2 and ν_4 bands with the correlation functions given by the extended J-diffusion model. (auth)

2669 STARK−ZEEMAN HYPERFINE STRUCTURE OF $H^{79}Br$ AND $H^{81}Br$ BY MOLECULAR-BEAM ELECTRIC-RESONANCE SPECTROSCOPY. Dabbousi, O. B.; Meerts, W. L.; de Leeuw, F. H.; Dymanus, A. (Katholieke Univ., Nijmegen, Netherlands). Chem. Phys. (Amsterdam); 2: No. 4, 473-477 (Dec 1973).

We used the molecular-beam electric-resonance (MBER) method to measure the Stark−Zeeman hyperfine structure of the molecules $H^{79}Br$ and $H^{81}Br$. For the ground vibrational state (v = 0) and the rotational state J = 1 we obtain for both molecules the electric dipole moment and hyperfine structure constants. For the $H^{81}Br$ molecule we also measured the magnetic molecular constants: $g_J = 0.37122(8)$, $\chi_{||} - \chi_{\perp} = -0.139(7)$ kHz kG^{-2}, $(\sigma_{av})_{Br} = 2748(40)$ (ppm), $(\sigma_{||} - \sigma_{\perp})_{Br} = 732(14)$ (ppm), and $(\sigma_{||} - \sigma_{\perp})_H = 24(12)$ (ppm). (auth)

2670 EFFECTS OF VARIATIONS IN REACTION COORDINATE EIGENVALUE ON HEAVY-ATOM KINETIC ISOTOPE EFFECTS: COMPARISON OF TWO METHODS FOR CURVING THE POTENTIAL BARRIER. Kidd, R. W.; Yankwich, P. E. (Univ. of Illinois, Urbana). J. Chem. Phys.; 60: No. 2, 610-619(15 Jan 1974).

The formic acid molecule is used as a model for a computational comparison of the Willi−Wolfsberg curvature parameter (K) method (Type K calculations) and the Johnston−Bonner−Wilson method (Type II calculations), both including bond order (N) and barrier curvature ($\nu_1^{\ddagger} \neq 0$) effects, for calculation of ^{13}C kinetic isotope effects involving reaction coordinate eigenvectors consisting nominally of two nonzero elements. Results obtained by the two methods cover similar ranges of value of calculated k_{12C}/k_{13C}. Reaction coordinate eigenvectors (uncontaminated for Type II results) may involve as much as 20% extraneous displacement in Type K results when $\nu_1^{\ddagger} \cong 800\ i\ cm^{-1}$; however, the effect on $(\nu_1^{\ddagger}/\nu_1'^{\ddagger})$, the temperature independent factor (TIF) in k_{12C}/k_{13C}, is so small as to be of limited practical significance. The remainder (TDF) of the isotopic rate constant ratio for various combinations of K and N (Type K) or of $\nu_1^{\ddagger}$ and N (Type II) can be arranged well into magnitude sequence by invocation of details of the input F and G matrices in the first order high temperature approximation. But, Type K and Type II results similar only with respect to barrier curvature (as indicated by value of $\nu_1^{\ddagger}$) may be very different. The Type K approach (at least for two-element reaction coordinates) seems the more serviceable for data matching and may be conceptually the simpler. The Type II approach, however, seems the more instructive concerning the influence of specific internal coordinate displacements on values of the kinetic isotope effect. (auth)

2671 THERMODYNAMIC PROPERTIES OF AQUEOUS ORGANIC SOLUTES IN RELATION TO THEIR STRUCTURE. Part I. Free Energy of Transfer from H_2O to D_2O for a Series of Isomeric Ketones. Jolicoeur, C.; Lacroix, G. (Univ. of Sherbrooke, Quebec). Can. J. Chem.; 51: No. 18, 3051-3061 (15 Sep 1973).

The solubilities of 18 decanones were measured in H_2O and D_2O at 25°C from their uv absorption spectra. The data were used to ΔG_t^0, the standard free energy of transfer of these solutes from H_2O to D_2O. ΔG_t^0 was found negative for the saturated ketones, but positive for most of the unsaturated and polycyclic isomers. A rough correlation was observed between ΔG_t^0 and the degree of branching in the hydrocarbon chains of the ketones: ΔG_t^0 increases with the degree of branching. From the temperature dependence of ΔG_t^0 obtained at 10, 25, and 40°C, heats of transfer ΔH_t^0 were determined for typical ketones, namely 2-decanone and adamantanone. ΔH_t^0 was found as −2.1 kcal mol^{-1} for 2-decanone and ~0 ± 0.5 kcal mol^{-1} for adamantanone. The results are discussed in terms of two main contributions: (1) an isotope effect in the free energy of cavity formation and (2) perturbation of solvent structure by the solutes, differing in H_2O and D_2O. Using the scaled-particle theory to evaluate the former, the variations in the observed ΔG_t^0 are assigned to the structural part of ΔG_t^0. (auth)

2672 PHOTOLYSIS OF AMMONIA AND OF PERDEUTERO-AMMONIA AT 185, 147, AND 123.6 nm. Masanet, J.; Fournier, J.; Vermeil, C. (CNRS, Paris). Can. J. Phys.; 51: No. 17, 2946-2951(1 Sep 1973). (In French).

A very important isotopic effect for the ratio of molecular and atomic hydrogen yield in the photolysis of ammonia at 147 and 123.6 nm was found. The dissociation $NH_3 + h\nu \rightarrow NH\ (X^3\Sigma^-) + H + H$ occurs for wavelengths as high as 147 nm which implies that $D_{NH-H} \leq 90$ kcal mol^{-}. The rate constant of the reaction $D + ND_3 \rightarrow D_2 + ND_2$ has been evaluated $k = 3.5 \times 10^{13} \exp(-14400/RT)\ cm^3\ mol^{-1}\ s^{-1}$. (auth)

2673 EMISSION SPECTRA OF THE MOLECULE PO: TRANSITIONS $D^2\Pi - B^2\Sigma^+$ AND $D'^2\Pi - B^2\Sigma^+$ OF THE MOLECULES $P^{16}O$ AND $P^{18}O$. Reconsideration of the Valence State $D'^2\Pi$. Coquart, B.; Da Paz, M.; Prudhomme, J. C. (CNRS, Reims Cedex, France). Can. J. Phys.; 52: No. 2, 177-186(15 Jan 1974). (In French).

New vibrational levels of the $D'^2\Pi$ state for $P^{16}O$ and $P^{18}O$ interacting with the level v = 0 of the $D^2\Pi$ state are studied by means of a transition to the $B^2\Sigma^+$ state. Deperturbation calculations have been carried out. The results obtained lead us to look at two hypotheses. In particular, the eventuality is considered that $D'^2\Pi$ and $B'^2\Pi$ are the same state, some high levels of which are observed here. (auth)

2674 EMISSION SPECTRA OF THE MOLECULE PO: STUDY OF THE $^2\Sigma^+$ STATES SITUATED IN THE ENERGY DOMAIN 50,000 TO 58,000 cm^{-1} OF THE MOLECULES $P^{16}O$ AND $P^{18}O$. Ngo, T. A.; Da Paz, M.; Coquart, B.; Couet, C. (CNRS, Reims Cedex, France). Can. J. Phys.; 52: No. 2, 154-176(15 Jan 1974). (In French).

The rotational analysis of bands of $P^{16}O$ and $P^{18}O$ molecules has been carried out by emission experiments. These bands, all perturbed, correspond to transitions from $A^2\Sigma^+$, $F^2\Sigma^+$, $G^2\Sigma^+$, $H^2\Sigma^+$ and $I^2\Sigma^+$ to $B^2\Sigma^+$, $A^2\Sigma^+$, and $X^2\Pi$ states in the respective regions 3850-5300, 6500-7000, and 1800-2000 Å. The results of first- and second-order deperturbations for the observed interactions give the values of the constants of the F, G, H, and I states with a better accuracy than that obtained previously by Verma et al. Particularly, they infirm the hypothesis of a predissociation of some vibrational levels by the repulsive $A'^2\Sigma^+$ state and permit the assignment of a new quantum specification to the $H^2\Sigma^+$ state. The electronic structure and the order in energy of the Rydberg states considered are then consistent to those which have been proposed by Ackermann et al. (auth)

2675 PSEUDO-THERMODYNAMIC PARAMETERS AND ISOTOPE EFFECTS FOR HYDROLYSIS OF A SERIES OF BENZYL CHLORIDES IN WATER. Koshy, K. M.; Robertson, R. E.; Strachan, W. M. J. (Univ. of Calgary, Alberta). Can. J. Phys.; 51: No. 17, 2958-2962(1 Sep 1973).

The temperature coefficient of the enthalpy of activation for the hydrolysis of p-methyl, p-chloro and p-nitro benzyl chlorides has been determined, as well as α-deuterium isotope effects and kinetic solvent isotope effects. These results are discussed in terms of probable mechanism of hydrolysis in water. (auth)

2676 REDUCTION OF CHLORO- AND AQUOPENTAKIS-ALKYLAMINOCOBALT(III) IONS BY Fe(II) IN NITRIC ACID SOLUTION. Mitzner, R.; Depkat, W. (Paedagogische Hochschule, Potsdam, Ger.). Z. Phys. Chem. (Leipzig); 254: No. 3/4, 196-202(1973). (In German).

Chloro- and aquopentakisalkylaminocobalt(III) ions were reduced in acid solution by Fe(II). The reduction of the chloropentakisalkylaminocobalt(III) ions can be described by the rate law $-dc/dt = k \times c_K \times c_{Fe^{2+}}$. In contrast to the reduction of the chloropentakisalkylaminocobalt(III) ions there is a pH dependence for the aquopentakisalkylaminocobalt(III) ions. The rate law is $-dc_K/dt = k \times c_K c_{Fe^{2+}} / c_{H^+}$. Both reactions are slower in D_2O than in H_2O. (tr-auth)

2677 PHOTODIMERIZATION KINETICS OF THYMINE-H_2 AND THYMINE-D_2. Borkmanm, R. F.; Yamanashi, B. S. (Georgia Inst. of Tech., Atlanta). Photochem. Photobiol.; 19: No. 2, 173-176(Feb 1974).

Substituent and solvent deuterium isotope effects on the direct and acetone-sensitized kinetics of thymine photodimerization in liquid acetonitrile and frozen aqueous solutions were studied. The thymine-h_2-acetonitrile and thymine-d_2 acetonitrile systems were irradiated at room temperature using a 1000-W xenon lamp and water filter while the thymine-h_2-H_2O and thymine-d_2-D_2O systems were immersed in liquid nitrogen. It was concluded that while there was a significant deuterium isotope effect on the phosphorescence lifetime of thymine in certain frozen media at 77°K there was little or no deuterium isotope effect on the rate of photodimerization in ice at 77°K or in acetonitrile solution at 25°C. (UK)

2678 ANHARMONICITY CORRECTION FOR KINETIC ISOTOPE EFFECT CALCULATIONS INVOLVING HYDROGEN ISOTOPES. Bron, J. (Natal Univ., Durban, S. Afr.). J. Chem. Soc., Faraday Trans., II; 70: No. 2, 240-243(1974).

Depending upon the force field, the anharmonicity correction for kinetic isotope effect calculations, based on simplified reacting systems representing a 1,2 hydride shift, may be large. For example, for deuterium and tritium kinetic isotope effects, calculated by means of the usual harmonic approximation, the anharmonicity correction is, at 300°K and for a particular force field, 0.74 or 0.66 respectively. (auth)

2679 γ-DEUTERIUM ISOTOPE EFFECTS ON SOLVOLYSIS OF 7-HALONORBORNYL BROSYLATES-6-d. Werstiuk, N. H.; Timmins, G.; Capelli, F. P. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 20, 3473-3476(15 Oct 1973).

The γ-deuterium isotope effects for the solvolysis of anti- and syn-7-bromo-exo-2-norbornyl brosylates-6-endo-d and syn-7-chloro-exo-2-norbornyl brosylates-5,6-exo, exo-d_2 in 80:20 EtOH-H_2O, 0.04 M NaOAc at 65° are 1.11 ± 0.01, 1.11 ± 0.01, 1.13 ± 0.01, 1.05 ± 0.01, and 1.11 ± 0.01, respectively. The results indicate that the γ-isotope effect observed in the solvolysis of exo-norbornyl brosylate likely is not derived via neighboring group (non-vertical) participation of the C_1-C_6 bond. (auth)

2680 ν_5 FUNDAMENTAL BANDS OF N_2H_2 AND N_2D_2. Carlotti, M. (Instituto di Chimica Fisica e Spettroscopia, Bologna); Johns, J. W. C.; Trombetti, A. (National Research Council of Canada, Ottawa). Can. J. Phys.; 52: No. 4, 340-344(15 Feb 1974).

The infrared absorption spectrum of diimide (N_2H_2) in the 3.2-μm region has been reexamined at higher resolution than previously, and that of dideuterodiimide (N_2D_2) at 4.3 μm has been recorded for the first time. The ν_5 fundamental (A- and B-type hybrid band) for both isotopic molecules has been analyzed, and a complete set of rotational and centrifugal distortion constants for the ground and $\nu_5 = 1$ states have been determined. The rotational constants of the ground states are (cm^{-1}) [N_2H_2: A 10.00021 ± 0.00023; B 1.304194 ± 0.000047; and C 1.149861 ± 0.000042] [N_2D_2: 6.02490 ± 0.00021; 1.089385 ± 0.000063; and 0.919525 ± 0.000054] and the following geometrical parameters were obtained for the planar trans-conformation of diimide: $r_{N-H} = 1.028 \pm 0.005$ Å; $r_{N-N} = 1.252 \pm 0.002$ Å; $\angle$ N-N-H = 106°51′ ± 28′. From the intensity alternation observed in the J structure of N_2H_2 spectrum, it is concluded that diimide has a totally symmetric ground state. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 4494.

2681 (INIS-mf-887-1, pp 84-100) POSSIBLE APPLICATION OF ISOTOPE EXCHANGE IN CONCENTRATION-SEPARATION PROCESSES IN SERIES ANALYSIS. Palagyi, S.; Zaduban, M. (Safarika Univ., Kosice, Czech.). [nd]. (In Russian).

The separation is discussed of unstable nuclides proceeding in a heterogeneous liquid medium and having a high chemical yield and a high degree of concentration, by the one-stage isotope exchange under static ($f = F/p \gg 1$, where $p > 1$ and F is the ratio of specific volumes, p is the ratio of phase volumes and f is the isotope exchange yield) and dynamic (if the ratio of $F/p > 1$ is low) conditions. In static conditions and with a great number of samples the multi-stage exchange is unsuitable for separation. Unlike the multi-stage exchange in static conditions, the dynamic condition exchange is not elaborate, possible losses are minimized and the separation time is shortened. The advantage of the dynamic condition exchange is that, as against the one-stage exchange, at the same yield and at the same value of F, a much higher degree of concentration can be achieved. The isotope exchange in dynamic conditions can successfully be applied in a series analysis in processing large-volume, very low-activity samples. (INIS)

2682 TEMPERATURE DEPENDENCE OF THE ISOTOPIC LIQUID-VAPOR FRACTIONATION FACTOR FOR NITRIC OXIDE. Eshelman, D.M.; Torre, F.J.; Bigeleisen, J. (Department of Chemistry, University of Rochester, Rochester, New York 14627). J. Chem. Phys. 60: No. 2, 420-426 (15 Jan 1974).

The $^{15}N/^{14}N$ isotope fractionation factor between NO liquid and vapor has been determined in the temperature range 110-173°K. The results are in good agreement with the isotopic vapor pressure data of Clusius et al., which cover the range 110-121°K. The isotope fractionation data follow the T^{-2} law up to 135°K. A refinement of the T^{-2} law analysis of the isotopic vapor pressure data given by Bigeleisen in 1960 has been carried out by the harmonic oscillator cell model to include T^{-1} and T^0 terms. It is shown that the T^{-2} terms from the dimerization of the monomer in the liquid and the hindered translation and rotations of the dimer dominate the isotope fractionation factor. The falloff from the T^{-2} law for the liquid-vapor fractionation factor in NO is steeper than in argon. This is reconciled with the dissociation of the dimer in the liquid and the association of the monomer in the vapor at high temperatures. (auth)

2683 DETERMINATION OF TYPES OF HOMOLECULAR OXYGEN EXCHANGE AT OXIDES. Muzykantov, V. S.; Panov, G. I.; Boreskov, G. K. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Catal. (USSR) (Engl. Transl.); 14: No. 4, 828-834(1973).

Translated from Kinet. Katel.; 14: No. 4, 948-955(1973).

An analysis was made of the kinetic equation for redistribution of the isotopic oxygen molecules $^{16}O_2$, $^{16}O^{18}O$, and $^{18}O_2$ as a result of homomolecular exchange at the surface of an oxide, which proceeds according to three independent mechanisms: (1) without participation of oxygen from the surface layer; (2) with participation of one oxygen atom from the surface layer of the oxide in the limiting stage of the exchange; and (3) with participation of two such atoms. Methods are proposed for determining the rates of different types of exchange at homogeneous and inhomogeneous surfaces, proceeding from experimental data on the kinetics of the change in molecular-oxygen isotope composition. (LK)

2684 FRACTIONING OF HYDROGEN ISOTOPES IN THE BIOSYNTHESIS OF CERTAIN AROMATIC CONSTITUENTS OF PLANTS. Bricout, J.; Merlivat, L.; Koziet, J. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. D; 277: No. 10, 885-888(10 Sep 1973). (In French).

The biosynthesis of certain aromatic compounds in plants involves deuterium depletion. This depletion is more important for terpenes (the formation of which involves acetylcoenzyme A) than for compounds derived more directly from the degradation of glucose. Studies of the D/H ratio can be used to provide information on the origin of certain substances. (FR)

2685 D/H AND $^{18}O/^{16}O$ FRACTIONATION IN ICE-WATER SYSTEM. Suzuoki, T.; Kimura, T. (Meteorological Coll., Chiba, Japan). Shitsuryo Bunseki; 21: No. 3, 229-233(Sep 1973).

The equilibrium hydrogen and oxygen isotope fractionations in ice-water system were determined under the condition of comparatively slow rate of ice formation using mass spectrometric isotope analysis of coexisting ice and water. The values of hydrogen and oxygen isotope fractionation factors were determined to be 1.0206 ± 0.0005 and 1.0028 ± 0.0001, respectively. (auth)

2686 UNCOUPLED REPRESENTATIONS IN HYDROGEN ISOTOPE EXCHANGE REACTIONS. Garnett, J. L.; West, J. C. (Univ. of New South Wales, Australia). J. Phys. Chem.; 78: No. 10, 984-989(9 May 1974).

A mathematical analysis of the rate equations for both stepwise and multiple exchange of hydrogen isotopes in molecules containing N kinetically equivalent exchangeable hydrogen atoms is presented. The solutions are obtained in terms of a transform function $E_m(t)$ which can be used to transform experimental data to an uncoupled representation. This uncoupled representation provides N independent tests for correspondence between experimental data and the kinetic assumptions. The application of the uncoupled representation to the analysis of experimental data is illustrated for (i) stepwise exchange using literature data for the deuteration of ammonia and neopentane on heterogeneous platinum and nickel and (ii) multiple exchange using the deuteration of benzene with a homogeneous $PtCl_3^-$ catalyst. Very frequently undeuterated substrate is exchanged with a fully enriched deuterium source and therefore an Appendix of the constants necessary for transformation of experimental data under these conditions is provided. (auth)

2687 CHROMATOGRAPHIC SEPARATION OF THE NUCLEAR-SPIN ISOMERS OF HYDROGEN AND DEUTERIUM BELOW 60°K. Purer, A.; Kaplan, R. L. (Dept. of the Interior, Amarillo, TX). J. Chromatogr. Sci.; 9: No. 1, 59-62(1971).

A soft-glass capillary column (82 metres × 0.28 mm), internally etched with 10% NaOH solution to increase the surface area by ≈10%, was used for the separation of He, para- and ortho-hydrogen, and para- and ortho-deuterium. The operating temperature of 29 to 60°K was obtained by use of a helium refrigerator. Purified Ne was used as carrier gas. (Anal. Abstr.)

2688 SPECIFIC ACTIVITY OF SILICA SUPPORTED PLATINUM FOR THE CATALYSIS OF HYDROGEN-METHANE DEUTERIUM EXCHANGE. Sagert, N. H.; Poutsu, R. M. L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Phys.; 51: No. 21, 3588-3595(1 Nov 1973).

Rate data are reported as a function of temperature for the exchange of D_2 with CH_4 over a number of platinum-silica catalysts. Two different methods of preparing catalysts, impregnation and ion exchange, were used to get two series of metal particle sizes. Within each series, the particle size was increased by sintering batches in air at temperatures to 800°C. These methods produced platinum particles ranging from 0.9 to 10 nm diameter. The metal surface areas were measured by hydrogen chemisorption and, where possible, by x-ray diffraction and electron microscopy. The specific rate coefficients per unit surface area of platinum varied by a factor of up to 40 within each series and reached a maximum for sintering temperatures of about 500°C. The maximum specific rate coefficients for CH_4 conversion at 200°C, and total pressure of 60 kN m^{-2}, were 1.3 and 1.9×10^{-6} mol CH_4 m^{-2} s^{-1} for the ion-exchanged and impregnated catalysts respectively. Activation energies were in the range 60 to 100 kJ mol^{-1}. Since a relatively small change in specific rate coefficient was noted between the two series as compared to the changes within each series, no large effect of particle size on the specific rate coefficient was demonstrated. The different specific rate coefficients within the series are ascribed to other effects of sintering, particularly the formation of the lower energy Pt(111) surface. Some evidence was noted for a particle size effect in the distribution of products, with more multiple exchange being observed for the smallest particles. (auth)

2689 ISOTOPE EXCHANGE REACTION OF ZINC IN CYSTEINE COMPLEX. Samochocka, K.; Szczepanska, A. (Univ., Warsaw). Radiochem. Radioanal. Lett.; 17: No. 2, 105-110 (20 Apr 1974). (In German).

Isotope exchange reaction between $^{65}ZnCl_2$ and $^{64}ZnL_2$ (L = cysteine) was studied. The experimental value for the equilibrium constant suggests complicated zinc isotope exchange in ZnL_2 cysteine complex. Possible reaction mechanism including the formation of $^{65}ZnL_2$ was considered. (auth)

2690 MODIFIED SYSTEM FOR DEUTERIUM PRODUCTION. Thayer, V. R. (to Canadian General Electric Co. Ltd.). Canadian Patent 933,108. 4 Sep 1973.

The first stage of an improved GS-type hydrogen sulfide–water exchange process for heavy-water manufacture operates at an elevated pressure, preferably 300 psig. The depleted water leaving the hot tower is flashed through a reducing valve to boil off hydrogen sulfide. The bubbles of hydrogen sulfide are then removed in a stripper column, the process being aided by injection of steam at the bottom of the column. The hydrogen sulfide mixed with water vapor passes through a cooler-condenser to dry it, and is added to partly pressurized incoming water in an absorber tower. (CA)

2691 EXTRACTION OF DEUTERIUM FROM HYDROGEN GAS USING AMINES IN A BITHERMAL PROCESS. Bancroft, A. R. (to Atomic Energy of Canada Ltd.). Canadian Patent 918,382. 9 Jan 1973.

In a preferred embodiment of the invention, deuterium is extracted from ammonia synthesis gas (a mixture of nitrogen and hydrogen) by amines. The synthesis gas is first enriched slightly by contacting it with liquid 1,2-diaminopropane (containing a basic catalyst) in a hot tower (+90°C), then depleted more than it has been enriched by liquid methylamine (containing catalyst) in a cold tower (–90°C). The depleted synthesis gas is removed for ammonia synthesis. The methylamine (as vapor) is then depleted while the 1,2-diaminopropane is enriched in an exchange tower at +90°C. Some of the latter is bled off, and first enriched, then depleted in a cold tower at –30°C and a hot tower at 90°C by contacting with a closed-circuit stream of synthesis gas or hydrogen. Some of the secondarily enriched 1,2-diaminopropane is contacted with ammonia in a secondary exchange tower. The ammonia's deuterium content is thereby raised from 75,000 to 150,000 ppM, and some of it can be distilled to any required deuterium content. (CA)

Feed Materials Processing

Refer also to abstract 3131.

2692 (NIM-1550) FUNDAMENTAL STUDY OF THE DISSOLUTION IN ACID SOLUTIONS OF URANIUM MINERALS FROM SOUTH AFRICAN ORES. Laxen, P. A. (National Inst. for Metallurgy, Johannesburg (South Africa)). 21 May 1973. 143p. INIS.

The leaching behavior of a number of ores and samples was studied by a novel leaching technique, a so-called dilute leach. This method enabled an assessment of the various chemical factors in the acid leaching of the uranium ores. A major factor that results in the uranium in the ores not dissolving in practice appears to be impurities such as phosphate derived from the ores and present in the leaching solutions. This deleterious effect of phosphate ions in relatively low concentration is not due, as shown, to their complexing action with ferric ions or to an inhibiting effect on uraninite, but is attributed to an inhibiting action on a postulated phosphate-bearing mineral, termed altered uraninite. A second objective of the study was a determination of the fundamental factors affecting the dissolution of uraninite in acidic solutions of ferric sulfate, as represented by the overall equation, $UO_2 + Fe_2(SO_4)_3 \rightarrow UO_2SO_4 + 2FeSO_4$. The results obtained were used to determine the factors involved in the dissolution of UO_2 (and hence uraninite), and a mechanism for the overall dissolution reaction is postulated and discussed. A subsequent electro-chemical investigation of the dissolution of UO_2 was undertaken by other workers at the NIM. Where the studies overlapped, this electrochemical investigation confirmed the results of the study of the overall dissolution reaction. The Butler–Volmer equation was used to derive mathematical relationships covering the effect of Fe^{3+} and of Fe^{2+} on the dissolution rate of UO_2. The results obtained in this present study were found to fit these relationships. (INIS)

2693 (Y-DA-5510) BIOLOGICAL DENITRIFICATION DISPOSAL TECHNIQUES. Francke, H. C.; Clark, F. E.; Strohecker, J. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 21p. (CONF-740406-4). Dep. NTIS $4.25.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Laboratory and pilot-plant investigations at the Oak Ridge Y-12 Plant have shown that it is technically feasible to remove nitrates from neutralized waste solutions by a biological denitrification process. Acidic process effluents containing 15 to 50% nitrate ion are first neutralized with hydrated lime and diluted to obtain 10 to 13% nitrate ion in solution prior to feeding into a suspended growth-type biological reactor. No packing media is required due to the presence of colloidal precipitates and significant growth of bacteria. Bacteriological denitrification is a dissimilatory process in which the nitrate ion is reduced to nitrogen gas by specific bacteria. The process requires anaerobic conditions and an organic carbon source as well as other life-sustaining compounds such as phosphates and sulfates. The denitrification process was evaluated on a laboratory scale and in a 4000-gallon suspended growth bacteria reactor for pilot plant studies. Detention times for batches varied from 6 to 16 days depending on operating parameters and feed conditions. Recently, development studies have been focussed on continuous flow systems with work on batch reactors discontinued. These studies have shown that such systems can be continuously operated using an inlet feed concentration of 13% nitrate ion and an effluent concentration of less than 1000 μg/g nitrate ion. Studies have shown that an average of 1.5 pounds of nitrate

ion per day were decomposed in a 15.8-gallon continuous flow vessel at an average flow-through rate of 1.23 gallons/day and a residence time of 12.8 days. (auth)

2694 USE OF MICRO-ORGANISMS FOR LEACHING PROCESSES. Schwartz, W. (Technische Univ., Brunswick). Metall.; 27: No. 12, 1202-1206(Dec 1973). (In German).

The paper discusses the currently known methods of leaching heavy metal ores by means of bacteria. The experiments carried out to date have shown two types of thiobacillus (Th. thiooxidans and Th. ferrooxidans) to be effective for a wide range of sulfidic, oxidic, carbonatic and even silicatic ores. Technical processes are currently developed and tested in the USA, UdSSR, Canada and Australia as well as in the GDR. Apart from a number of more conventional techniques based on simple leaching according to the percolator principle, that are used for substrates with low ore content, some new, faster high-power processes are being developed where the bacteria are used for leaching suspensions of ore concentrates. (GE)

Radiation Chemistry

Refer also to abstracts 2643, 2644, 3346, 3351, 3473–3475, 3484, 3485, 3540, 3578, and 4076.

2695 (AD-769302) CHEMICAL REACTIONS INDUCED BY ULTRAVIOLET AND IONIZING RADIATION. Final Report. Hammond, G. S. (California Inst. of Tech., Pasadena (USA). Dept. of Chemistry). 1973. 10p. NTIS $2.75.

Catalysis of nonradiative decay processes in the electronically excited states of organic molecules was studied. There were two complementary approaches: (1) study of quenching of fluorescence, and (2) study of bichromophoric compounds which contain an aromatic nucleus and another group of a type normally involved in bimolecular quenching. Results are briefly discussed. (GRA)

2696 (AECL-4670) VARIABLE-TEMPERATURE APPARATUS FOR PULSE RADIOLYSIS STUDIES AT WHITESHELL NUCLEAR RESEARCH ESTABLISHMENT. Lopata, V. J.; Geoffrey, L. E.; Dixon, R. S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1974. 22p. Dep. NTIS (US Sales Only) $4.25. AECL $0.50.

A variable temperature apparatus used at Whiteshell Nuclear Research Establishment (WNRE) for pulse radiolysis studies in the range 80 to 350 K is described. The apparatus comprises a variable temperature cell housing, temperature controller, irradiation cell and flow system. Use of cold, dry N_2 gas and cartridge heaters permits rapid attainment of the desired temperature which is then kept constant to within 1 K by the temperature controller. The flow system allows remote sample changing to prevent build-up of radiation products. (auth)

2697 (CEA-R-4493) ELECTRON SPIN RESONANCE STUDY FREE RADICALS PRODUCED BY GAMMA IRRADIATION IN PLASTIC COMPOUNDS DERIVED FROM BICYCLO-(2-2-1)HEPTANE. Gloux, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Mar 1974. 145p. (In French). Dep. NTIS (US Sales Only) $10.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The ESR study of free radicals produced by gamma irradiation of derivatives of bicyclo(2-2-1)heptane was facilitated by the movements that exist in plastic phase. A marked inequivalence of the β proton couplings as well as the existence of strong and stereospecific hyperfine interactions with γ protons was observed. These couplings are discussed. Two methods of calculation, PCILO and INDO, were applied to these radicals to obtain theoretical hyperfine couplings. The results are consistent with experimental couplings. (auth)

2698 (COO-2147-12) PREPARATION AND CHARACTERIZATION OF BIOCOMPATIBLE POLYMERS BY RADIATION GRAFTING AND RADIOISOTOPE TECHNIQUE. Technical Progress Report, June 15, 1973–April 22, 1974. Lentz, D. J.; Andrade, J. D. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). Apr 1974. Contract AT(11-1)-2147. 49p. Dep. NTIS $5.50.

Progress in studies on the grafting of hydroxyethyl methacrylate (HEMA) monomer to various substrates for medical applications is reported. The HEMA monomer was analyzed for impurities and methods for purifying it were developed. A method for preparation of 2,3-dihydroxypropyl methacrylate (DHPMA) was developed. Grafting experiments were expanded to include both gas and solution phase grafting using uv radiation and radiofrequency glow discharge initiation. Data on the % weight increases of HEMA grafted to polypropylene in the solution phase using uv initiation are given. A pulsing diaphragm apparatus and a pressurized blister apparatus were built to test the mechanical behavior of the grafts. Tensile data indicate that the HEMA gel is much weaker than the tested supporting material, silastic rubber. Biological studies have been directed toward optimization of an ex vivo system designed for evaluation of the blood compatibility of substrate materials. (JGH)

2699 (IAE-2216) GAMMA RADIATION EFFECT ON THE DTPA AQUEOUS SOLUTION STABILITY IN LACTIC AND ASCORBIC ACIDS FROM THE POINT OF VIEW OF TRANS-PLUTONIUM AND RARE EARTH ELEMENT SEPARATION. Erin, E. A.; Kazakova, G. M.; Kosyakov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 7p. (In Russian). INIS.

The first results are reported from the study of the radiation stability of lactic and ascorbic acids and of Na_5DTPA under the effects of γ radiation used for the separation of transplutonium and rare earth metal elements. The radiation stability of the irradiated system was determined by the change of the acidity of the solution and of the coefficient of distribution of Cm, Bk, and Ce during extraction with 0.5 M D2EHPA in decane. The curves for the pH change of the solution and the dependence of the distribution coefficient on the amount of energy absorbed by all systems in the limits from 0 to 1.0 Wh/hr were given. It was shown that in the systems studied a radiolytic decomposition of the lactic and ascorbic acids and the Na_5 DTPA occurs. The system with lactic acid can sustain a larger radiation dose than the system with ascorbic acid. The curves obtained make possible a quantitative analysis of the effect of radiation on the process of separation of the transplutonium and rare earth elements (particularly Bk and Ce) and provide measures to compensate this effect. (tr-auth)

2700 (N-74-13825) TRAPPING OF HYDROGEN ATOMS IN X-IRRADIATED SALTS AT ROOM TEMPERATURE AND THE DECAY KINETICS. May, C. E.; Philipp, W. H.; Marsik, S. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jan 1974. 13p. NTIS $2.75.

The salts (hypophosphites, formates, a phosphite, a phosphate, and an oxalate) were x-irradiated, whereby hydrogen formed chemically by a radiolytic process becomes trapped in the solid. By room-temperature vacuum extraction, the kinetics for the evolution of this trapped hydrogen was studied mass spectrometrically. All salts except two exhibited second-order kinetics. The two exceptions ($NaH_2PO_2(H_2O)$ and K_2HPO_4) showed first-order kinetics. Based on experimental results, the escape of hydrogen involves three steps: the diffusion of hydrogen atoms from the bulk to the surface, association of these atoms on the surface (rate controlling step for second-order hydrogen evolution), and the desorption of molecular hydrogen from the surface. The hydrogen does not escape if the irradiated salt is stored in air, apparently because adsorbed air molecules occupy surface sites required in the escape mechanism. (auth)

2701 (NSRDS-NBS-44) RADIATION CHEMISTRY OF GASEOUS AMMONIA. Peterson, D. B. (Notre Dame Univ., Ind. (USA). Radiation Lab.). Feb 1974. 40p. GPO $0.70.

H_2 and N_2 are the only significant products of radiolysis of gaseous ammonia under static conditions at dose rates less than about 10^{19} eV · g^{-1} s^{-1}; and $G(H_2) = 5.0 \pm 1.0$ and $G(N_2) = 1.7 \pm 0.3$ for irradiation at 20°C and pressures near one atmosphere. Yields do not appear to depend significantly upon LET (Linear energy transfer); and they are independent of dose up to at least 8×10^{22} eV/g. In static systems at dose rates $\geq 10^{26}$ eV · $g^{-1}s^{-1}$, and in flow systems, N_2N_4 is also a product. At dose rates less than 10^{19} eV · $g^{-1}s^{-1}$, $G(-NH_3)$ increases markedly with temperature and reaches a plateau value of about 10 at temperatures near 150 – 200°C. At very high dose rates ($\geq 10^{26}$ eV · $g^{-1}s^{-1}$) $G(-NH_3)$ increases significantly at higher temperatures (value depends upon dose rate) and $G(-NH_3)$ does not appear to be leveling off at the highest temperature studied (460°C). In both dose rate regions the increase in $G(-NH_3)$ is attributed primarily to the increasing importance of $NH_2 + H \rightarrow NH_2 + H_2$ with increasing temperature. $G(-NH_3)$ also appears to increase with decreasing dose rate. However, the effect is less pronounced than the effect of temperature, and the experimental evidence is not unequivocal. NH and HN_2 have been observed spectroscopically in pulse radiolysis of NH_3 and such studies lead to $g(NH) = 0.4$. However, this value of g(NH) is low because of errors in dosimetry. $g(NH_2)$ was not obtained directly because the absorptivity of NH_2 was not available. A number of additives has been employed in attempts to determine primary yields of other species involved in radiolysis; however, results with different additives and from different laboratories are in good agreement only in the case of $g(H_2)$ (0.7 – 0.8) and $g(NH_4^+)$ (3.3 –

3.9). The best value of g(H) appears to be 10.4 ± 0.6; and this is the preferred value. $g(NH_2)$ is obtained from the material balance, $g(H) + 2g(H_2) = g(NH_2) + 2g(NH)$. The preferred value of g(NH) is 0.75, i.e., $g(NH) = g(H_2)$ and this leads to $g(NH_2) = 10.4$. (auth)

2702 (ORO-3799-8) SPIN INTERACTIONS BETWEEN SLOW ELECTRONS AND AMINO ACID FILMS. Final Report, 1 June 1968–28 February 1972. Yeargers, E. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 1972. Contract AT(40-1)-3799. 31p. Dep. NTIS $4.75.

Research progress is reported on a study of the possibility of spin exchange between incident electrons and orbital electrons of evaporated films of aromatic amino acids. Such spin exchange can lead to long-lived excited triplet states, whose lifetimes and reactivities make them a potential biological hazard. Spin exchange is expected to be most significant for electrons with energies below about 100 eV, such as might be formed in the energetic cascade following the freeing of a fast electron by x-ray absorption. The research was intended to provide information concerning the interactions between solid amino acids and free electrons with energies greater than uv quanta, less than x-ray quanta, and in the region near 100 eV, below which spin exchange should become important, i.e., in the "transitional region". (auth)

2703 MICELLAR EFFECTS IN THE RADIATION CHEMISTRY OF PYRIMIDINE BASES. Infante, G. A. College Station, TX; Texas A and M Univ. (1973). 166p. University Microfilms Order No. 74-1018.

Thesis (Ph. D.).

The yields of the radiolytic products in the reactions of ·OH, e^-_{aq} and H· with thymine and uracil and those in the reactions of e^-_{aq} and ·OH/O^- with ionized thymine and uracil have been determined quantitatively in ^{60}Co γ-irradiated aqueous thymine and uracil solutions in the presence of suitable scavengers. Based on the obtained yields of the products and the available literature, mechanisms for the radiolysis of thymine and uracil in aqueous solutions are proposed and discussed. The destruction yield of thymine and uracil and the yields of the corresponding radiolytic products decrease in the presence of micelle-forming surfactants mainly at concentrations above the CMC. These micellar effects in the radiation chemistry of thymine and uracil are discussed in terms of competition kinetics between the surfactants and the pyrimidines for the radiolytic species formed in the radiolysis of water and in terms of solubilization of transients and intermediates by the micellar surfactants. (LK)

2704 ON THE SOLVATION OF THE TRAPPED ELECTRON IN γ IRRADIATED DEUTERATED ETHANOL GLASS AT 4 K. Bales, B.L. (Department of Physics and Astronomy, California State University, Northridge, Northridge, California 91324); Kevan, L. J. Chem. Phys. 60: No. 2, 710-711 (15 Jan 1974).

EPR data of trapped electrons (e_t^-) in γ-irradiated polar glasses is analyzed. It is assumed that e_t^- is not fully solvated when produced at 4°K and that it subsequently becomes fully solvated upon warming to 77°K. (AIP)

2705 YIELD OF SOLVATED ELECTRONS IN PULSE RADIOLYSIS OF LIQUID AMMONIA. Farhataziz; Perkey, L.M.; Hentz, R.R. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 60: No. 2, 717-718 (15 Jan 1974).

The yield of solvated electrons from the pulse radiolysis of liquid ammonia has been measured. A pulsed electron beam of energy 8 Mev was used in this study. The results are in accord with Ward [B. Ward, Advan. Chem. Ser. 81, 601 (1968)]. The solvated electron yield for liquid ammonia obtained in the present study is $g(e^-_{am}) = 3.2$. (AIP)

2706 COMPUTER SIMULATION OF (n, γ) RECOIL DAMAGE IN HEXAHALORHENATE CRYSTALS. Robinson, M.T. (Institut für Festkörperforschung, Kernforschungsanlage Jülich, 517 Jülich, Germany); Rössler, K.; Torrens, I.M. J. Chem. Phys. 60: No. 2, 680-688 (15 Jan 1974).

A comprehensive computer program, originally written to simulate radiation damage in metals, has been applied to a study of recoil damage following (n, γ) activation of the halogen ligands in crystals of $K_2[ReCl_6]$, $K_2[ReBr_6]$, and their mixtures. Calculations were made of the retention of radiohalogen in the complex anions and of the primary retention of the radiohalogens in their own original ions, both quantities as functions of the initial recoil energy. Assuming a volume for the spontaneous recombination of vacancies and interstitials containing about 50 halogen sites, good agreement is achieved between the calculations and recent experiments in the pure crystals. The retention was found to be independent of recoil energy, a result which appears to be quite general. Failure of the calculations to account for the very low retention of radiochlorine in dilute solutions of $K_2[ReCl_6]$ in $K_2[ReBr_6]$ is attributed to difficulties of energy accomodation between nearly thermal Cl recoils and the host crystal. (auth)

2707 FREE RADICALS IN PYRIMIDINES: ESR OF X-IRRADIATED 5-ETHYLBARBITURIC ACID AND ITS POTASSIUM SALT. Gutierrez, P. (Department of Physics, Southern Illinois University, Carbondale, Illinois 62901); Benson, B. J. Chem. Phys. 60: No. 2, 640-644 (15 Jan 1974).

Irradiation of 5-ethylbarbituric acid yields a free radical formed by hydrogen abstraction from C(5) of the pyrimidine ring. The characteristics of this radical are similar to those of the same radical formed by abstraction of an ethyl group from 5,5-diethylbarbituric acid. There is no evidence of an ethyl abstraction radical in this compound, indicating that the abstraction of the hydrogen rather than the ethyl is highly preferred. Irradiation of the potassium salt of 5-ethylbarbituric acid yields a free radical formed by hydrogen abstraction from the ethyl group. Principal values are as follows: $g_1=2.0032$, $g_2=2.0031$, $g_3=2.0025$, $A^H_1=26.4$ G, $A^H_2=16.5$ G, $A^H_3=10.9$ G, $A_1{}^{CH_3} = 21.0$ G, $A_2{}^{CH_3} = 20.5$ G, $A_3{}^{CH_3} = 19.6$ G. Only one molecule per unit cell was observed magnetically, although the crystal structure would indicate that two or three should be seen. The formation of this hydrogen abstraction radical is surprising because a simple ionization of the parent molecule would yield the very stable radical observed in 5-ethylbarbituric acid and 5,5-diethylbarbituric acid. (auth)

2708 ESR STUDY OF ^{13}C HYPERFINE SPLITTINGS FOR THE SINGLE LINE RADICAL PRODUCED IN γ IRRADIATED SINGLE CRYSTALS OF SUCCINIC ACID. Yim, M.B.; Klinck, R.E. (Department of Chemistry, University of Connecticut, Storrs, Connecticut 06268). J. Chem. Phys. 60: No. 2, 538-540 (15 Jan 1974).

ESR studies of γ-irradiated single crystals of succinic acid-d_4 have enabled evaluation of ^{13}C hyperfine splittings for the single line radical species. The data confirm the structure as $HOOCCH_2CH_2\dot{C}=O$. Isotropic ^{13}C hyperfine splittings of 131.8 and 47.7 G have been obtained for the carbonyl carbon and the adjacent methylene carbon. Spin density calculations show that majority of the unpaired electron density is localized in the δ orbital arising from the rupture of a C–OH bond in the undamaged molecule. (auth)

2709 ELECTRON-TUNNELLING MODEL FOR RECOMBINATION OF AROMATIC HYDROCARBON RADICAL IONS IN NON-POLAR SOLVENTS. Brocklehurst, B. (Univ. of Sheffield, Eng.). Chem. Phys. (Amsterdam); 2: No. 1, 6-18(Sep 1973).

An electron-tunneling model is used to describe the recombination of ions such as $(naphthalene)^+$ with anions or solvated electrons in alkanes; theoretical difficulties and estimation of the barrier height are discussed. Recombination in solids can take place over large distances (~ 50 Å). Transfer distances in liquids are obtained by comparing the rate of approach of the ions with the tunnelling rate: in viscous liquids, the distances are again large–the ions do not make contact. A new tunnelling formula is constructed which incorporates Franck–Condon factors; it is used for illustrative calculations of the relative rate constants for production of excited singlets and triplets. Tunnelling rates and the overall recombination time are compared with spin-relaxation rates to assess the probability of variations in the singlet–triplet ratio; possible effects of viscosity and external magnetic fields are discussed. (auth)

2710 EFFECT OF PHOTOIONIZATION ENERGY ON THE DISTANCE DISTRIBUTION BETWEEN TRAPPED ELECTRONS AND N,N,N',N'-TETRAMETHYL-P-PHENYLENEDIAMINE CATIONS IN ORGANIC GLASSES. Moeckel, H.; Yuen, J.; Kevan, L. (Wayne State Univ., Detroit). Contract AT(11-1)-2086. J. Phys. Chem.; 77: No. 25, 3035-3036(6 Dec 1973).

An effect of photoionization energy on the distance distribution between trapped electrons and N,N,N',N'-tetramethyl-p-phenylenediamine cations in 2-methyltetrahydrofuran and 3-methylpentane glasses at 77°K is demonstrated. It is shown that the electrons travel further before trapping when photoionized by higher energy light. (LK)

2711 BrO DISAPPEARANCE IN THE PULSE RADIOLYSIS OF $O_2 + Br_2$ AND $N_2O + Br_2$ SYSTEMS. Cahill, R. W.; Riley, J. F. (Lockheed Palo Alto Research Lab., CA). Radiat. Res.; 58: No. 1, 25-37(Apr 1974).

The BrO transient formed during the pulse radiolysis of $O_2 + Br_2$ mixtures decayed according to second-order kinetics, and the rate constant decreased slightly as O_2 pressure was increased from 400 to 1560 Torr. Besides the variation with pressure, the BrO recombination reaction exhibited an initial phase in the time regime 3 to 50 μsec under certain experimental conditions during which BrO disappearance occurred at a faster rate. In the pulse radiolysis of $N_2O + Br_2$ mixtures, the kinetics of BrO disappearance were found to be sensitive to the dose. In the lower dose range used in this work, the second-order rate plots were linear

and BrO decay was invariant with pressure. With mixtures irradiated to a higher dose, BrO decay was also rapid but did not follow simple kinetics. The molar extinction coefficient of BrO was measured at three wavelengths in the near-uv region by determining the amount of Br_2 that temporarily disappears during radiolysis. The molar extinction coefficient ($M^{-1} \times cm^{-1}$) was found to be 1,620 at 338 nm, 1,500 at 333 nm, and 1,530 at 321 nm. (auth)

2712 RADIATION CHEMISTRY OF DNA MODEL COMPOUNDS. III. γ-Radiolysis of 2-Deoxy-D-Ribose in the Crystalline State. Conversion of 2-Deoxy-D-Ribose into 2,5-Dideoxy-D-Erythro-Pentonic Acid via a Chain Reaction. von Sonntag, C.; Neuwald, K.; Dizdaroglu, M. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Radiat. Res.; 58: No. 1, 1-8(Apr 1974).

In the γ-radiolysis of crystalline 2-deoxy-D-ribose, 2,5-dideoxy-D-erythro-pentonic acid is formed via a chain reaction with an initial G value >650. (auth)

2713 REACTION OF CYTOCHROME C WITH ONE-ELECTRON REDOX REAGENTS. I. Reduction of Ferricytochrome c by the Hydrated Electron Produced by Pulse Radiolysis. Lichtin, N. N.; Shafferman, A.; Stein, G. (Hebrew Univ., Jerusalem). Biochim. Biophys. Acta; 314: 117-135(1973).

Pulse radiolysis–kinetic spectrometry was used to investigate the reaction of hydrated electrons with ferricytochrome c in dilute aqueous solution at pH 6.5 to 7.0. Time resolutions from $2 \cdot 10^{-7}$ to 1 s were employed. Transient spectra from 320 to 580 nm were characterized with a wavelength resolution of ±0.5 nm. In neutral salt-free solution, k(ferricytochrome c + e^-_{aq}) = $(6.0 \pm 0.9) \cdot 10^{10}$ $M^{-1} \cdot s^{-1}$ and k(ferricytochrome c + H) = $(1.2 \pm 0.2) \cdot 10^{10}$ $M^{-1} \cdot s^{-1}$. The reaction of ferricytochrome c with hydrated electrons is sensitive to ionic strength; in 0.1 M $NaClO_4$, k(ferricytochrome c + e^-_{aq}) = $(2.4 \pm 0.4) \cdot 10^{10}$ $M^{-1} \cdot s^{-1}$. In contrast, k(ferricytochrome c + H) is insensitive to ionic strength. Time resolution of three spectral stages has been accomplished. The primary spectrum is the first observable spectrum detectable after irradiation and is formed in a second-order process. Its rate of formation is indistinguishable from the rate of disappearance of the electron spectrum. The secondary spectrum is generated in a true first order intramolecular process, k(p → s) = $(1.2 \pm 0.1) \cdot 10^5$ s^{-1}. The tertiary spectrum is also generated in a true first-order process, k(s → t) = $(1.3 \pm 0.2) \cdot 10^2$ s^{-1}. The specific rates of both transformations are independent of the wavelength of measurement. The tertiary spectrum, observable 50 ms after initial reaction and remaining unchanged thereafter for at least 1 s, shows that relaxed ferrocytochrome c is the only detectable product. This product is not autoxidizable, as expected for native reduced enzyme. It is more probable that the intramolecular changes responsible for the p → s and s → t spectral transformations involve the influence of conformational relaxation of ferricytochrome c upon electronic energy states than that they are intramolecular transmission of reducing equivalents from primary sites of electron attachment. (auth)

2714 REVIEW OF NUCLEAR SOURCES OF NON-FOSSIL CHEMICAL FUELS. Steinberg, M. (Brookhaven National Lab., Upton, NY). Energy Sources; 1: No. 1, 17-29(Fal 1973).

From symposium on non-fossil chemical fuels; Boston, MA (Apr 1972).

Energy derived from nuclear sources can be utilized either in the form of high-energy radiation, thermal energy, or electrical energy. Each of these energy forms can be employed to produce non-fossil chemical fuels by transformation of available non-fossil substances such as the substances found in water, air, and minerals. High-energy radiation from nuclear fission can be utilized either directly as fission-fragment energy in a chemonuclear reactor, or indirectly as neutron, gamma, and beta energy from isotopic sources. Fission-fragment energy is actually the only radiation-energy source that can be generated in sufficient quantity and at low enough cost to be considered for production of fuels. The two basic fuels that can be generated are hydrogen from water and CO from carbon dioxide. The hydrogen and CO can be used as fuels or can be subsequently converted to high-BTU gas or other liquid hydrocarbons. Thermal energy from nuclear fission in the form of steam or a high-temperature gas stream such as helium can be used to crack water to hydrogen and carbon dioxide to CO. Carbon dioxide can be derived from thermal decomposition of limestone or by extraction from the atmosphere. Nuclear thermal energy can be used to preheat streams and make up heat balances and to gasify coal. Nuclear-based electrical energy derived from standard steam and gas power cycles or from more advanced cycles such as magnetohydrodynamics can be utilized to power electrolytic cells or electric discharges. In electrolytic cells water can be decomposed to hydrogen and oxygen. The hydrogen can be used as a primary source of fuel or converted to a number of other fuels including ammonia, methanol, methane, hydrazine, acetylene, and others. The electric discharge can also be employed to decompose water and carbon dioxide. Aluminum, magnesium, and other reactive metals can be electrochemically produced and used as fuels. A practical source of nuclear-based non-fossil chemical fuels is the nuclear-fission reactor powered electrolytic decomposition of water to hydrogen. Boranes and silanes can be derived from hydrogen, borax, and silica. Fusion energy will replace fission as a nuclear source and can be applied to produce non-fossil chemical fuels. (auth)

2715 LIGHT EMISSION RESULTING FROM ION-RECOMBINATION IN THE PULSE-RADIOLYSIS OF ARGON CONTAINING NAPHTHALENE OR ANTHRACENE. Sauer, M. C. Jr.; Mulac, W. A. (Argonne National Lab., IL). Int. J. Radiat. Phys. Chem.; 6: No. 1, 55-65(Feb 1974).

Light emission from the lowest excited singlet states of naphthalene and anthracene was observed in the pulse-radiolysis of argon gas containing either of these substances. These states are formed, in part, via ion-recombination, and analysis of the emission decay curves allows the determination of the ion-recombination rate constants. In the naphthalene system, the electron-positive ion reaction has a rate constant of $(4 \pm 1) \times 10^{-6}$ cm^3 ion^{-1} s^{-1} (120 to 200°C, 0 to 2.3×10^{19} molecules argon/cm^3), and in the anthracene system, the anthracene negative ion reacts with positive ions with rate constants of $3.7 \pm 0.3 \times 10^{-7}$ and $2.4 \pm 0.2 \times 10^{-7}$ cm^3 ion^{-1} s^{-1} at 1.91×10^{19} and 0.652×10^{19} molecules argon/cm^3, respectively, at 195 ± 5°C. (auth)

2716 PHOTOCHEMICAL AND γ-RAY-INDUCED REACTIONS OF NUCLEIC ACID CONSTITUENTS. Dealkylation of 8-α-HYDROXYALKYL PURINES. Salomon, J.; Elad, D. (Weizmann Inst. of Science, Rehovot, Israel). J. Amer. Chem. Soc.; 96: No. 10, 3295-3299(15 May 1974).

The photosensitized dealkylation of 8-α-hydroxyalkyl purines with ultraviolet light (λ > 290 nm) leads to the regeneration of the original purines in yields of up to 100%. A mechanism involving an electron transfer from the excited sensitizer to the purine molecule is proposed. The dealkylation of 8-α-hydroxyalkyl purines could also be achieved by the γ radiolysis of their aqueous solutions. (auth)

2717 ROLE OF FREE RADICALS IN THE RADIATION CHEMISTRY OF POLYMERS. Turner, D. T. (Drexel Inst. of Tech., Philadelphia). J. Polym. Sci., Part D; 5: 229-383(1971).

Areas covered in this review include: formation and distribution of intermediates; distribution and estimation of intermediates by electrical conductivity, electron spin resonance spectroscopy, visible, ultraviolet, and infrared absorption spectroscopy; accumulation of radicals; disappearance of radicals; yields of products; scavenging of intermediates; and chemistry of intermediates. (368 references) (LK)

2718 DETERMINING THE FREE AMMONIA BY γ-RADIOLYSIS OF WATER SOLUTIONS OF AROMATIC AMINES. Karaivanov, I. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 24: 205-211(1973). (In Bulgarian).

A method is presented for separation of ammonia by adsorption of the organic components with activated carbon. The separation is accomplished by filtration of the investigated samples through a glass filter on which a layer of activated carbon is deposited. The organic components are completely adsorbed while the ammonia passes quantitatively into the filtrate. A method is developed for removing the pollutions which are eluted from the activated carbon and hamper the determination. Conditions for the quantitative penetration of the ammonia through the filter are also given. The determination is carried out photocolorimetrically with Nessler's reagent. The method is elaborated on the basis of irradiated aniline water solutions. (auth)

2719 DETERMINATION OF HYDROGEN PEROXIDE IN RADIATION–CHEMICAL INVESTIGATIONS OF WATER SOLUTIONS OF AROMATIC AMINES. Karaivanov, I.; Pumpalov, I. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 24: 213-219(1973). (In Bulgarian).

A method for determining the hydrogen peroxide is given, in which the organic components are removed by adsorption with activated carbon. During the treatment of the sample, a change takes place in the concentration of the hydrogen peroxide as well. The dependence of the decrease of the initial concentrations of hydrogen peroxide on the amount of activated carbon used and on the duration of the sample treatment is given. It is shown that for 0.004 g/cm^3 of activated carbon and a duration

of the treatment about 1 min, the organic products are absorbed completely and the hydrogen peroxide losses are negligible. Pollutions eluted from the activated carbon during the treatment do not hamper the determination when Hromolli and titanium methods are used. A scheme for the determination is presented. The method is developed on the basis of irradiated aniline water solutions. (auth)

2720 RECENT DEVELOPMENTS IN IRRADIATION PROCESSING. Danno, A. (Japan Atomic Energy Research Inst., Gunma). Radioisotopes (Tokyo); 21: No. 8, 516-528(Aug 1972). (In Japanese).

The 1970s will see the commercial utilization of radiation in chemistry, food and medicine. In view of the remarkable advances in the 1960s, application will also be expanded to the solution of public-hazard problems. The utilization of radiation can be divided into three phases: (1) processes industrialized in early days, (2) those industrialized recently, and (3) those forthcoming in the near future. The recent developments in this field are described on the following: modification of high molecular compounds, including crosslinking of polyethylene, foaming polyethylene, and dissociation of polyethylene oxide; radiation graft copolymerization, such as that of polyethylene, polyvinyl chloride and fibers; radiation polymerization, like ethylene in gas phase, trioxane in solid phase, paint curing, wood-plastic compound, and concrete-polymer compound; radiation synthesis, i.e. bromination of ethylene, sulfonation and chlorination of hydrocarbons and telomerization of ethylene; radiation sterilization with γ rays and electron beams; and food irradiation. (JA)

2721 RADIOLYTIC ENERGY TRANSFER INDUCED BY RARE GASES. Kevan, L. (Wayne State Univ., Detroit). Contract AT(11-1)-2086. pp 89-121 of Advances in Radiation Research. Vol. I. Duplan, J. F. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From fourth international congress of radiation research, Evian, France (28 Jun 1970).

The type and populations of energy transfer species in irradiated rare gases are discussed. Both monoatomic and diatomic ions must be considered in gases while only diatomic species seem important in condensed phases. Ions dominate 2 : 1 over excited states. A revised interpretation of the relation between W-values for rare gases and the numbers of ions and excited states is presented. An operational definition of overall energy transfer efficiency in irradiated rate gas-foreign molecule mixtures is applied to available experimental data and the selectivity of product formation by energy transfer is briefly examined. (auth)

2722 PULSE RADIOLYSIS STUDIES OF CHLORIDE COMPLEXES OF THALLIUM(II). Absorption Spectra and Stability Constants of $TlCl^+$, $TlCl_2$, and $TlCl_3^-$. Dodson, R. W.; Schwarz, H. A. (Brookhaven National Lab., Upton, NY). J. Phys. Chem.; 78: No. 9, 892-899(25 Apr 1974).

Three chloride complexes of Tl(II) were identified in a study of the effect of chloride ion on the spectrum of Tl(II) produced by pulse radiolysis. Absorption maxima are found at 263 and 342 nm for $TlCl^+$, at 280 and 342 nm for $TlCl_2$, and at 304 and 362 nm for $TlCl_3^-$. The stability constants of the three complexes are 6.2×10^4, 1900, and 13 M^{-1}, respectively. The rate constant for dissociation of $TlCl^+$ into Tl^{2+} and Cl^- is 1.4×10^5 sec^{-1} and the rate constant for the reverse reaction is 9×10^9 M^{-1} sec^{-1}. The Tl(II) produced by the radiation pulse disappears by disproportionation to T(I) and Tl(III) at diffusion-controlled rates. The rate constant for oxidation of Tl(I) by Cl_2^- is 5×10^9 M^{-1} sec^{-1}. The rate constant for reduction of $TlCl^{2+}$ by hydrogen atoms is 5×10^8 M^{-1} sec^{-1}, and is 2×10^9 M^{-1} sec^{-1} for the other three Tl(III) complexes: $TlCl_2^+$, $TlCl_3$, and $TlCl_4^-$. These hydrogen atom rate constants are larger than that for Tl^{3+}, contrary to expectations based on free-energy considerations. It is proposed that the preferred reduction path is by ligand abstraction whenever possible. It was found that the principal product of H atom reduction of $TlCl^{2+}$ is Tl^{2+}, not $TlCl^+$, in support of this mechanism. (auth)

2723 ELECTRON SPIN RESONANCE OF γ-IRRADIATION-INDUCED FREE RADICALS IN POLYVINYLPYRIDINES. Ronfard Haret, J. C.; Lablache Combier, A.; Chachaty, C. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. Chem.; 78: No. 9, 899-907(25 Apr 1974).

Free radicals formed by γ irradiation of polyvinylpyridines in bulk or in glassy solutions were identified by electron spin resonance. In neutral alcoholic solutions, pyridinyl radicals produced by hydrogen addition to nitrogen are selectively formed. Analysis of ESR spectra shows that the methine proton of the chain is located in the plane of the pyridyl ring. When these polymers are irradiated in glassy concentrated hydrochloric acid, the nitrogens being protonated, hydrogen atom addition occurs to a ring carbon with formation of an azacyclohexadienyl radical. Likewise vinylpyridinyl and methylazabenzyl radicals are formed when vinylpyridine monomers are irradiated in neutral and acidic matrices, respectively. The hyperfine coupling parameters determined from these radicals formed in specific conditions allowed the assignment of the spectra of bulk irradiated polymers to pyridyl and pyridinyl radicals. (auth)

2724 RADIOLYSIS AND PHOTOLYSIS OF THE HYDROGEN PEROXIDE–P-NITROSODIMETHYLANILINE–OXYGEN SYSTEM. Hatada, M.; Kraljic, I.; El Samahy, A.; Trumbore, C. N. (Univ. of Delaware, Newark). J. Phys. Chem.; 78: No. 9, 888-891(25 Apr 1974).

The γ ray radiolysis and ultraviolet photolysis of aerated solutions of p-nitrosodimethylaniline (RNO) containing hydrogen peroxide were studied and compared. The same intermediate, the OH radical, appears to be solely responsible for the destruction of the RNO molecule in both the photolysis and radiolysis systems. Identical competition kinetics are found between RNO and hydrogen peroxide for the OH radical over a wide range of both RNO and hydrogen peroxide concentrations. Hydrated electron scavenging by high concentrations of hydrogen peroxide yields an intermediate which has the same kinetic behavior as that from the hydrogen peroxide photolysis. Evidence is given that the previously reported G values for radiolytic destruction of RNO were too low since one or more products of the reaction with OH absorb at 440 nm. However, the relative rate constants obtained from competition kinetics are not altered when this is taken into account, provided OH competitors completely scavenge the RNO bleaching reaction. An absolute quantum yield of 0.92 ± 0.10 is found for RNO destruction in aerated H_2O_2 solutions. This value would also be equal to the quantum yield for H_2O_2 decomposition, assuming the same stoichiometry as in the radiolysis. However, this would be larger by a factor of 2 than that which is commonly accepted. The reasons for this discrepancy may be mechanistic but, if so, the difference between the radiolysis and photolysis mechanisms is unexplained. (auth)

2725 PULSE RADIOLYTIC STUDY OF Ni^+. Nickel–Carbon Bond Formation. Keim, M.; Lilie, J.; Henglein, A.; Janata, E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys. Chem.; 78: No. 9, 882-887(25 Apr 1974).

Deaerated aqueous solutions of $NiSO_4$ were irradiated with ^{60}Co γ rays or by single pulses of high-energy electrons. The solutions contained aliphatic alcohols, diethyl ether, c-pentane, or formate as scavengers for OH and H radicals. Metallic nickel was precipitated from some of these solutions on γ irradiation. Reactions between Ni^+ and organic radicals leading to organic nickel compounds were observed in the pulse experiments using both optical and conductimetric detection methods. The rate constants of reactions of Ni^+ with organic radicals are of the order of 10^9 M^{-1} sec^{-1}. The reaction $2Ni^+ \rightarrow Ni + Ni^{2+}$ was not observed under these conditions. Nickel formation is attributed to the attack of radicals on the organic nickel compounds. These compounds can be oxidized by H_2O_2 with rate constants of 10^4–10^8 M^{-1} sec^{-1}. They react slowly with water, the lifetime being somewhat less than 1 sec in the cases of methanol and ethanol and longer in the other cases. Only the $\cdot CH_2C(CH_3)_2OH$ radical does not form a complex but is rapidly reduced to yield isobutene. The complex formed from Ni^+ and CO_2^- rapidly picks up a proton. (auth)

2726 ELECTRON CAPTURE IN γ-IRRADIATED METHYLCYCLOHEXANE GLASS. Truong, T. B. (Univ., Paris); Bernas, A.; Roncin, J. J. Phys. Chem.; 78: No. 9, 867-869(25 Apr 1974).

Recent and present stimulated luminescence experiments have shown (besides trapped electrons e_t^-) a solvent-derived negative species X^- in γ-irradiated methylcyclohexane (MCH) glass or in uv-excited TMPD-MCH system at 77°K. In the former case, an ir e_t^- bleaching is necessary for X^- formation. The following conclusions are made. (1) The small decrease—$\Delta[X]$ due to X^- formation has not been detected by EPR but a comparison with the uv-excited TMPD-MCH case makes plausible that X is the methylcyclohexyl radical $R\cdot_{MCH}$. (2) X^- production efficiency examined as a function of e_t^- bleaching wavelength displays a sharp maximum and its resonance character resembles that of a typical resonance electron attachment cross-section curve. (3) An INDO calculation of the lowest electronic energy states of the π and σ structures of $R\cdot_{MCH}$ and $R\cdot_{MCH}^-$ has shown that electron attachment to $R\cdot$ is not expected to occur in the gas phase and that the attachment observed in the solid phase necessitates a distortion from $R\cdot(\pi)$ to $R\cdot(\sigma)$. The energy ($\approx$0.2 eV) corresponding to the maximum of X^- formation efficiency curve may correlate with the activation energy of this π to σ structural change. Implications on electron kinetic energy relaxation in γ-irradiated glasses and phase effects on electron attachment processes are evoked. (auth)

2727 RADIATION CHEMISTRY AND ACCELERATORS. Tabata, Y. (Tokyo Univ.). Genshiryoku Kogyo; 19: No. 5, 9-15 (May 1973). (In Japanese).

The present condition and the trend of the utilization of accelerators in the field of radiochemistry in Japan and the United States were shown in the tables and explained. Ford Motor Co. adopted the electron-beam coating system which is used in the manufacturing line (i.e., coating process as coating technique). Raychem Corporation manufactures new products by irradiating plastics and elastic bodies. In Firestone Rubber Co., rubber sheet containing filling up substances is irradiated at dose of about 4 Mrads in order to increase toughness of rubber sheet. In Western Electric Co., the accelerator is used in the process of bridge building of insulated wire cable. In General Cable Co., insulated cables are irradiated. Radiation Development Co. adopted accelerator for pulp and paper manufacturing process for the first time. Electronized Chemical Co., Radiation Dynamics Co., Columbia Research Corp. and RAI Corp. are exploiting the original technique and carrying out irradiation service requested from the outside. Sumitomo Electric Industries Ltd. adopted the accelerator mainly for gel formation of polyethylene. Sekisui Chemical Co. Ltd. established manufacturing technique of forming polyethylene by radiation and exports this technique to the United States and Switzerland. Toyo Rayon established the technique for various foaming substances and manufactures them continuously. Japan Electrocure Ltd. sells the electron-beam hardening technique and carries out technical service. Mitsubishi Rayon introduces Pittsburgh Glass Co.'s technique and makes experiments in pilot scale such as hardening of coating with paint and manufacture of plastics and complexes. As present condition of radiation process in various countries in Europe, Atomic Energy Research Institute of Sacre-Coeur in France, Compagnie Francais de Raffinage, Otto Dur Co. BASF in Germany and Atomic Energy Research Institute of Risó in Denmark, etc. are mentioned. There is a great difference in the process adopted by the above-mentioned institutes between the time of realization and the expected time of realization, but it was clarified that commercialized process has a characteristic and merits being worth using radiation. (JA)

2728 CHEMICAL AND PHYSICAL CHANGES IN FOOD PACKAGING MATERIALS EXPOSED TO IONIZING RADIATION. Killoran, J. J. (Army Natick Lab., MA). Radiat. Res. Rev.; 3: No. 4, 369-388(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Research that was performed to determine to what extent gamma and electron radiation at food sterilizing doses altered the chemical and physical properties of (a) the polymeric films used for the flexible packages; (b) the cellulosic materials of fiberboard and paperboard boxes; and (c) the components of the tinplate container is reviewed. (LK)

2729 QUALITATIVE AND QUANTITATIVE ASPECTS OF TRACE VOLATILE COMPONENTS IN IRRADIATED FOODS AND FOOD SUBSTANCES. Merritt, C. Jr. (Army Natick Lab., MA). Radiat. Res. Rev.; 3: No. 4, 353-368(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Irradiation of foods and food substances results in the formation of trace amounts of a large number of volatile compounds. The role that such trace components may play in the wholesomeness of irradiated foods is of interest. A detailed consideration of both the qualitative and quantitative aspects of these volatile compounds found within a wide spectrum of foods and food substances has been undertaken to try to correlate the great mass of analytical data which has become available in the last decade, to see if any comparisons can be adduced which relate the composition of trace volatile components in irradiated products to those found in more familiar foods. (LK)

2730 EFFECTS OF IONIZING RADIATIONS ON CARBOHYDRATE SYSTEMS. Phillips, G. O. (Univ. of Salford, Eng.). Radiat. Res. Rev.; 3: No. 4, 335-351(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Topics discussed include: radiolysis of aqueous solutions, radiolysis of crystalline carbohydrates, radiolysis of carbohydrates when in association with other molecules, and direct and indirect production of radicals. (LK)

2731 INITIAL ION-PAIRS IN PULSE-IRRADIATED WEAKLY POLAR LIQUIDS. Shaede, E. A.; Kurihara, H.; Dorfman, L. M. (Ohio State Univ., Columbus). Int. J. Radiat. Phys. Chem.; 6: No. 1, 47-54(Feb 1974).

The formation and decay of pyrenide ions were observed, with nanosecond time resolution, in pulse-irradiated solutions of pyrene in diethylamine (DEA) and tetrahydrofuran (THF), both weakly polar liquids. The complex decay of the pyrenide ion was interpreted in terms of the very fast "geminate" recombination of pyrenide ions with solvent counter-ions in the original ion-pair configuration as well as the homogeneous recombination of the "free" ions. The empirical "error-function" kinetic treatment for such decays, developed by Schuler et al., was applied to the experimentally observed rate curves. This application, which fits the experimental data quite well, leads to estimates of ionic escape probabilities of 0.03 for DEA and 0.08 for the THF. These escape probabilities correspond to "free-ion" yields (G_{fi}) of approximately 0.1 ion/100 eV for DEA and 0.3 ion/100 eV for THF based on the measured ionic yields for nanosecond pulses. This implies that the total ionization yield is approximately 4 in THF and 3 in DEA. (auth)

2732 RADIOLYTIC CHANGES IN FATS. Nawar, W. W. (Univ. of Massachusetts, Amherst). Radiat. Res. Rev.; 3: No. 4, 327-334(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Radiolytic changes in fats under non-oxidative conditions and mechanisms of radiolysis in triglycerides are discussed. (LK)

2733 RADIATION-INDUCED REACTIONS OF AMINO ACIDS AND PEPTIDES. Garrison, W. M. (Univ. of California, Berkeley). Radiat. Res. Rev.; 3: No. 4, 305-326(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

The radiolytic deamination of the simpler α-amino acids glycine and alanine is considered; the effects of gamma-rays on solid cysteine are discussed; and the radiation chemistry of peptides is reviewed. (50 references) (LK)

2734 RADIOLYSIS OF METHYL BENZOATE. Rohra, M. R.; Rao, K. N. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Chem.; 11: No. 10, 1060-1061(Oct 1973).

Methyl benzoate was radiolyzed using cobalt-60 γ rays. The products were analyzed by vacuum line technique and by GLC. The product yields are $G_{(CO_2)} = 0.18$, $G_{(CO)} = 0.13$, $G_{(H_2)} = 0.037$, $G_{(benzene)} = 2.50$ and $G_{(toluene)} = 1.75$. The formation of these products was explained as due to the free radicals and excited molecules generated by the interaction of γ-rays with methyl benzoate. (auth)

2735 REACTION OF THE SOLVATED ELECTRON WITH ORGANIC HALIDES. Logan, S. R.; Wilmot, P. B. (Strathclyde Univ., Glasgow). Int. J. Radiat. Phys. Chem.; 6: No. 1, 1-13 (Feb 1974).

Studies of the competition for hydrated electrons between N_2O and an organic halide, RX, performed by measuring the N_2 yields from the ultraviolet illumination of KI solutions containing these two solutes, lead to values of the relative rate constant in complete disagreement with the ratio of the absolute rate constants obtained by pulse radiolysis. This disagreement is found to persist when methanol is used as solvent, when (in aqueous solution) the hydrated electrons are generated by γ-radiolysis, and when N_2O is replaced by H^+. It is thus deduced that there is some mechanistic complication in the reactions and it is demonstrated that the data are more consistent with the scheme previously postulated by the present authors (Logan et al., Chem. Commun.; 558 (1966)) than with one analogous to that suggested by other workers as operative in some gas-phase systems. In the radiation chemical studies, high yields of X^- ion are found from all solutes, RX. The mechanism postulated by Teply (Colln. Czech. Chem. Commun.; 25: 24 (1960)) in regard to $CHCl_3$ does not appear adequate to explain the high yield of X^- from various RX and in the presence of OH scavengers. Their occurrence means that, mechanistic complications apart, relative rate constants cannot properly be deduced from halide yields in systems containing another solute. (auth)

2736 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. Hart, E. J. (Argonne National Lab., IL). Radiat. Res. Rev.; 3: No. 4, 285-304(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

The nature of the primary species and their radiation yields are indicated. Some of the important reactions involved in irradiated water, the effects of radicals on simple inorganic and organic solutes, the effects of concentration, pH, and oxygen are pointed out. (52 references) (LK)

2737 STIMULATION OF PHENOLIC BIOSYNTHESIS IN CITRUS FRUIT PEEL BY GAMMA RADIATION. Riov, J. (He-

brew Univ., Rehovot, Israel); Monselise, R.; Goren, R.; Kahan, R. S. Radiat. Res. Rev.; 3: No. 4, 417-427(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Responses of fruits to ionizing radiation have been determined at varying time intervals after exposure. Three main responses have been found to occur during or immediately after irradiation: textural changes, increased evolution of ethylene, and increase in respiration. Subsequently, progressive biochemical changes occur. One of the early biochemical changes is the stimulation of phenolic biosynthesis in citrus fruit peel. A pathway of phenolic biosynthesis is presented. (LK)

2738 X-IRRADIATION-INDUCED DEIODINATION OF O-IODOPHENOL IN AQUEOUS SOLUTION AT 25°C. Ehrl, A. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Nuremberg). Atomkernenergie; 22: No. 4, 272-276(1974). (In German).

10^{-3}M solutions of o-iodophenol in aerated doubly distilled water were irradiated at 25°C in a 50-kV x-ray unit at different doses. All organic irradiation products were free of iodine. Phenol and pyrocatechol, which were the main products, were formed after selective substitution of iodine by hydrogen atoms and hydroxyl radicals under the conditions of water radiolysis. The production of hydriodic acid proceeded parallel with the deiodination of o-iodophenol. Both processes were congruent with energetics: The reaction heat, calculated by means of bond energies, accorded with the difference between combustion heats of equivalent compounds. Additionally, o-iodophenol served as a model of thyroid gland hormones and their biological precursors. For example, 3-iodo-L-tyrosine was deiodinated under irradiation in the same way as o-iodophenol, yielding L-tyrosine and L-dopa. (GE)

2739 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED SILVER DIETHYL PHOSPHATE. Bernhard, W. A.; Ezra, F. S. (Univ. of Rochester, NY). J. Phys. Chem.; 78: No. 10, 958-961(9 May 1974).

Gamma irradiation of silver diethyl phosphate (AgDEP) at 77°K results in the formation of the $\dot{C}H_2CH_2O\text{-}P(O_2)OC_2H_5^-$ radical. Selective line broadening of the ESR spectrum is observed and attributed to a restricted motion of the $\dot{C}H_2CH_2^-$ moiety. Due to the electron-scavenging ability of the silver ions, other electron addition products, $CH_3\dot{C}H_2$ and $C_2H_5O\dot{P}O_2^-$, are not formed. Instead, the presence of Ag^0 is detected at 77°K. Concurrent with the decay of $\dot{C}H_2CH_2OP(O)_2OC_2H_5^-$ at 200°K is the appearance of a spectrum ascribed to $CH_3\dot{C}HOP(O)_2OC_2H_5^-$. The latter free radical decays at room temperature. (auth)

2740 COMPETITIVE AND NONCOMPETITIVE ELECTRON CAPTURE OF NITROUS OXIDE WITH SULFUR HEXAFLUORIDE AND ELECTRON THERMALIZATION IN THE GAS-PHASE RADIOLYSIS OF XENON. Hatano, Y.; Shimamori, H. (Tokyo Inst. of Tech.). J. Phys. Chem.; 78: No. 10, 954-958(9 May 1974).

The effect of the addition of SF_6 on the nitrogen yield in the gas-phase radiolysis of Xe, which is an "electron supplier," containing 3 to 20 mol % of N_2O was investigated. The decreasing nitrogen yield at higher concentrations of SF_6 (~2 mol % in Xe) is almost independent of the composition of the mixtures. The relative rate of the electron capture process of N_2O to that of SF_6 decreases apparently by a factor of 10^2 with increase in the N_2O mole percent. The kinetic treatment shows that nitrogen formation in this system results from two different electron capture processes of N_2O, that is, the dissociative electron attachment to N_2O during the course of its thermalization and the nondissociative thermal electron attachment to N_2O by a three-body process. The rate constant for electron capture by SF_6 is estimated to be $\sim 10^{-12}$ cm^3 $molecule^{-1}$ sec^{-1} which is much lower than that generally recognized. The yield of nitrogen nonscavengeable by SF_6 has been briefly discussed. (auth)

2741 IONIZATION CHAMBER STUDY OF ELECTRON AND ION DECAY IN IRRADIATED AMMONIA. McCracken, D. R.; Armstrong, D. A. (Univ. of Calgary, Alberta). Can. J. Phys.; 51: No. 24, 4159-4166(15 Dec 1973).

Ionization chambers with plane parallel and coaxial electrodes were used to study the ion and electron concentrations in ammonia subjected to 120 kvp x-ray pulses of 17 and 30 ms duration. Differences in the numbers of positive and negative ions collected on the application of pulses of high voltage imply that free diffusion of electrons to the cell walls occurs in the early part of the x-ray pulse until it is inhibited by the positive ion space charge. Thereafter, positive and negative ions decay at equal rates. The rate constant for the neutralization reaction, $e + NH_4^+ \cdot nNH_3 \rightarrow$ Neutral products at 1200 Torr of ammonia and 297°K, was calculated to be $4.2 \pm 1.0 \times 10^{-5}$ cm^3 $ions^{-1}$ s^{-1}. However, unless extensive precautions are taken to remove electron-attaching impurities reactions between $NH_4^+ \cdot nNH_3$ ions are dominant. The results are discussed and compared to other work on electron-ion neutralization reactions. (auth)

2742 RADIOLYSIS OF WATER VAPOUR AT VERY HIGH DOSE RATES. 1. Hydrogen Yields from H_2O, H_2O–HCl, and H_2O–HBr MIXTURES. Boyd, A. W.; Willis, C.; Miller, O. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 51: No. 24, 4048-4055(15 Dec 1973). (AECL-4641).

The plateau yields of hydrogen from the Febetron radiolysis of mixtures of water vapor with up to 8 mol % of HCl or HBr are $G(H_2) = 7.9 \pm 0.2$ and $G(H_2) = 4.6 \pm 0.2$ with 1 mol % SF_6. These yields are consistent with $G(H) = 7.45$ in pure water vapor and $G(H) = 4.15$ in water vapor with SF_6. In the Febetron radiolysis of pure water vapor at 2×10^{27} eVg^{-1} s^{-1} and densities of ~1 mg ml^{-1} $G(H_2) = 1.65 \pm 0.05$ from 164 to 190°C. This yield is reduced to $G(H_2) = 0.90 \pm 0.05$ on the addition of 1 mol % SF_6. Using a second order equivalent rate constant for the disappearance of the OH radicals in water vapor at 1 mg ml^{-1} of 2×10^{10} M^{-1} s^{-1} these yields are consistent with rate constant values for the reactions $H + OH(+H_2O) \rightarrow H_2O$, $OH + OH(+H_2O) \rightarrow H_2O_2$, and $H + H(+H_2O) \rightarrow H_2$, of $1.7 \pm 0.1 \times 10^{10}$ M^{-1} s^{-1}, $1.5 \pm 0.5 \times 10^9$ M^{-1} s^{-1}, and $3 \pm 1 \times 10^8$ M^{-1} s^{-1}, respectively. (auth)

2743 SPECIAL FEATURES OF THERMAL AND THERMAL-OXIDATIVE DEGRADATION OF IRRADIATED POLYOLEFINS. Pavlova, Zh. D.; Leshchenko, S. S.; Egorova, Z. S.; Karpov, V. L. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 16: No. 1, 111-118(Jan 1974). (In Russian).

The special features of thermal and thermal-oxidative degradation of high- and low-density polyethylenes and of ethylene–propylene copolymers, γ-irradiated with 1 to 300 Mrads, were studied. It was established that changes in the polymer structure upon irradiation resulted in an increase in the thermal stability and a decrease in the thermal-oxidation stability of the polymers. A suggestion is made that trans-vinyl unsaturation results in an increase in thermal destruction of the irradiated polymers, and that vinyl unsaturation slows down the process. It was found that the most vulnerable spots in the oxidation of irradiated polymers are the cross-linkages, tertiary carbon atoms, and alpha carbon atoms relative to the trans-vinyl double bond. Simultaneously with the oxidative destruction of the irradiated polymers, cross-linking occurs with formation of primary ester linkages. (tr-auth)

2744 HINDERED INTERNAL MOTION IN ALKYL RADICALS STABILIZED IN INCLUSION COMPOUNDS OF UREA WITH ALKYL HALIDES. Kuleshov, A. P.; Trofimov, V. I.; Chkheidze, I. I. (Inst. of Chemical Physics, Moscow). J. Struct. Chem. (USSR) (Engl. Transl.); 14: No. 4, 581-588(1973).

Translated from Zh. Strukt. Khim.; 14: No. 4, 625-633(1973).

Inclusion compounds of a series of alkyl halides with urea, γ-irradiated at −196°C, were investigated by the ESR method. Temperature changes in ESR spectra of alkyl radicals formed during irradiation of these systems are associated with internal rotation or vibration along the $C_\alpha - C_\beta$ bond in the radical. The form of ESR spectra of alkyl radicals as a function of the frequency of internal rotation P was calculated on an electronic computer. Dependences of P on temperature for alkyl radicals having various chain lengths, which are described by the Arrhenius law, were obtained on the basis of these calculations from experimental data. Parameters of these dependences P_0 and E_a, which do not depend on the nature of the halide, but depend on the chain length and symmetry of the alkyl radical, were determined. Two mechanisms are proposed for explanation of experimental data: a) interaction of the alkyl radical with urea molecules, forming canals; b) interaction of the alkyl radical with alkyl halide molecules in neighboring canals. (auth)

2745 SYNTHESES OF POLYMERS BY DESTRUCTIVE METHODS. II. Mechanochemical Complexation and Complexation by Irradiation Using ^{60}Co γ Rays in the System: Poly(Ethylene-terephthalate), Ethylenediamine, and Metallic Salts. Simionescu, C.; Oprea, C. V.; Negulianu, C. (Iasi Polytechnical Inst.). Rev. Roum. Chim.; 19: No. 2, 259-281(Feb 1974).

Destruction of heterochain polymers such as poly-(ethylene-terephthalate), achieved under the action of mechanical energy and of γ rays, is accompanied by the accumulation of an increasing number of functional end groups, able to react with suitable condensation agents existing in the working medium. When metallic salts are also present in system, the fragments synthesized by polycondensation act as macromolecular ligands. Processes of polycondensation and complexation activated by destructive methods are decisively influenced by some factors, as: processing time, ratio of reactants (polymer: diamine: metallic salt), temperature, and atmosphere (inert, oxygen, etc.) in which the reac-

tion occurs. These polycondensation and polycomplexation products exhibit sensibly different properties from those of the support polymers: increased thermal stability, permanent magnetic moment, and chemical resistance against some aggressive media (acids, bases, and solvents). (auth)

2746 NOVEL COATING METHOD. Nomura, S.; Honda, K.; Miyazaki, M.; Hirose, K.; Akiyama, K. (to Dainippon Ink and Chemicals, Inc.). Japanese Patent 1973,4444. 31 Mar 1969. 4p. (In Japanese).

The crosslinking curing of a layer of a resin composition applied to primer coating coated by cataphoresis onto the conductive material is carried out by ionizing radiation. In the process, (1) the substrate is at first cataphoretically coated with a water soluble or water suspensive resin composition in 1 to 10 microns thick, (2) the cataphoretically coated substrate is further coated with a resin composition comprising a resin of radical crosslinking type having an unsaturated active bond in its molecules and a radically polymerizable polymer having an unsaturated active bond to polymerize with said crosslinking type resin, and the crosslinking curing is carried out by ionizing radiation. (JA)

2747 GAMMA RADIOLYSIS OF BRANCHED CHAIN HYDROCARBONS. 2,3-Dimethylbutane. Castello, G.; Grandi, F.; Munari, S. (Univ., Genoa). Radiat. Res.; 58: No. 2, 176-189 (May 1974).

The gamma radiolysis of liquid 2,3-dimethylbutane at room temperature was investigated under vacuum. Iodine was used as a free radical scavenger and the formed alkyl iodides were analyzed by gas chromatography with an electron capture detector. Irradiations of frozen 2,3-dimethylbutane at 77°K were also performed. The fragmentation products and many of those having a number of carbon atoms higher than the parent were identified and measured. Formation of the identified heavy products is mainly due to recombination of radicals, as demonstrated by the comparison between their yields and those of alkyl iodides. (auth)

2748 EFFECTS OF METAL IONS ON THE γ-RADIOLYSIS OF POLYCRYSTALLINE DJENKOLIC ACID. Kominami, S.; Riesz, P. (National Cancer Inst., Bethesda, MD). Radiat. Res.; 58: No. 2, 154-165(May 1974).

Gamma radiolysis of polycrystalline djenkolic acid at room temperature produces two groups of carbon radicals. The radicals of group A either decay by a second-order reaction or are converted to sulfur radicals by a pseudo first-order process, while the radicals of group B can only be converted to sulfur radicals. The carbon radicals of groups A and B appear to be the same chemical species but differ in their microenvironments. Addition of Co^{2+}, Ni^{2+}, and Fe^{2+} at a ratio of 1 metal ion per 10 molecules of djenkolic acid decreases the initial yield of carbon radicals and increases the second-order decay rate and the percentage of carbon radicals belonging to group A. Addition of Na_2SO_4, $NaNO_3$, $CdSO_4$, and Ni^{2+} – EDTA has no effect. The second-order decay may be explained by a vacancy-controlled bulk-diffusion process; metal ions appear to exert their influence by increasing the number of lattice defects. Addition of certain metals, particularly Cd^{2+} and Ce^{4+} decreases the rate of conversion of the carbon radicals of group A to sulfur radicals. Ni^{2+} and Ce^{4+} ions also prevent the radio-induced destruction of sulfur radicals. The effects of metal ions on a variety of different processes can thus be differentiated in γ-irradiated djenkolic acid. (auth)

2749 FREE RADICALS IN PYRIMIDINES: ESR STUDY OF SELECTIVE ABSTRACTION OF C(5) SUBSTITUENTS BY X IRRADIATION. Gutierrez, P. (Southern Illinois Univ., Carbondale); Benson, B. Radiat. Res.; 58: No. 2, 141-153(May 1974).

Free radicals were produced by x irradiation in substituted barbituric acid derivatives by the selective abstraction of one of two groups on C(5) of the pyrimidine ring, leaving the unpaired electron localized on C(5). An ESR analysis of irradiated single crystals and polycrystalline samples of 5-methylbarbituric acid, 5-hydroxy-5-methylbarbituric acid, 5-hydroxy-5-ethylbarbituric acid and 5-ethyl-5-methylbarbituric acid leads to the following ordering for the ease of abstracting the various groups: $-H >> -CH_2CH_3 >> -CH_3$; $-OH > -CH_2CH_3$; $-OH > CH_3$. The abstraction of the ethyl group involves an intermediate radical $-CHCH_3$ formed by abstraction of hydrogen from the ethyl. It is postulated that the ethyl group is subsequently removed as ethene. Hyperfine coupling and g-value principal values are presented for those radicals not previously reported. (auth)

2750 RADIOLYSIS OF WATER VAPOUR AT VERY HIGH DOSE RATES. 2. Isotope Effects in the Hydrogen Yield From H_2O–D_2O Mixtures. Can. J. Phys.; 51: No. 24, 4056-4061(15 Dec 1973). (AECL-4642).

The isotope effect in the formation of hydrogen has been measured for H_2O–D_2O mixtures (10-90% H_2O, 0.5-1.0 mg ml^{-1}, 412-138°C) with and without 1 mol % SF_6 at 2×10^{27} eV g^{-1} s^{-1}. The values of α((H/D) radiolytic hydrogen/(H/D) H_2O–D_2O) for the reactions of hydrogen atoms are in the range 3-6 varying with H/D ratio of the substrate. Consideration of possible mechanisms for these large α values leads to the conclusions that reaction of the hydrogen atoms to form hydrogen involves the substrate and that the species H_2O may be formed as an intermediate. (auth)

2751 ION YIELDS AND FRAGMENTATION PROCESSES IN THE RADIOLYSIS OF HCl AND DCl. Carr, P. F.; Christiansen, P.; Wilson, D. E.; Armstrong, D. A. (Univ. of Calgary, Alberta). Can. J. Phys.; 52: No. 3, 359-364(1 Feb 1974).

The ionization yield from fast electron impact on DCl under radiolysis conditions at 200 to 650 Torr was found to be 1.006 ± 0.023 times that from HCl. Also primary ionization processes were investigated by mass spectrometry. The relative abundance of Cl^+ from HCl near threshold at 17.4eV was about twice that from DCl, but processes with onset at and above 21.0 eV did not exhibit an isotope effect. The interpretation of the results and their implications concerning the mechanism of radiolysis of HCl were discussed. (auth)

2752 SPECTRUM, KINETICS, AND RADIATION CHEMICAL YIELD OF SOLVATED ELECTRONS IN HEXAMETHYLPHOSPHORIC TRIAMIDE. Shaede, E. A. (Ohio State Univ., Columbus); Dorfman, L. M.; Flynn, G. J.; Walker, D. C. Can. J. Phys.; 51: No. 23, 3905-3913(1 Dec 1973).

The spectrum, yield, and kinetics of solvated electrons in hexamethylphosphoric triamide were investigated by the pulse radiolysis method. The optical absorption band is in the infrared with a maximum at 2200 ± 100 nm. The molar absorptivity at this maximum is $(3.2 \pm 0.5) \times 10^4$ M^{-1} cm^{-1}, and the oscillator strength for the transition is estimated to be $f = 0.7 \pm 0.2$. A free ion yield of 2.3 ± 0.4 solvated electrons/100 eV was determined from the observed yields of anthracene and pyrene radical anions formed by electron attachment. Kinetic studies provided values of the rate constants for the reaction of solvated electrons with anthracene and N_2O. The decay mechanism of the solvated electrons in the absence of added solutes was found to be complex, and the half-life (in the range of 2 to 50 μs) was dependent on experimental conditions. A second transient species, absorbing at wavelengths below 500 nm, was observed but not identified. In solutions containing bromide ion the species Br_2^- was observed. The pulse radiolysis of stable solutions of solvated electrons, formed by dissolving sodium metal in HMPA, is also reported. (auth)

2753 THEORETICAL TREATMENT OF RADICAL REACTIONS IN RADIATION CHEMISTRY SYSTEMS. Naumann, W.; Stiller, W. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Z. Phys. Chem. (Leipzig); 254: No. 5-6, 323-336(1973). (In German).

In a diffusion kinetic model the combination and recombination of radical primary products in radiation chemistry systems were treated by step-wise consideration of the correlations between the radical distributions. The change of the radical number of a "trace" was described by the time variation of the pair distribution functions of all possible radical pairings as a result of diffusion and reaction. The results were compared with those of earlier theoretical models which generally proceed from single particle distributions and assume the existence of reaction orders and time-independent reaction constants even in inhomogeneous distribution of the reactants. It was shown that the frequently used approximation of the prescribed diffusion method in the use of single-particle distribution functions sufficiently describe the pattern of the radical concentration when the initial phase of the process has decayed and no longer plays a role in the total change of the radical concentration. (tr-auth)

2754 ELECTRON MOBILITIES AND RANGES IN LIQUID C_1–C_3 HYDROCARBONS AND IN XENON: EFFECTS OF TEMPERATURE AND FIELD STRENGTH. Robinson, M. G.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 3, 440-446(1 Feb 1974).

Electron mobilities following pulsed irradiation with x rays were measured in ethane, ethylene, propane, cyclopropane, and propylene to complete studies of the lower hydrocarbons. The effects of temperature and field strength on the mobilities in those liquids and in methane, n-butane and xenon were also measured. The density-normalized range of the secondary electrons in each of the liquids is independent of temperature. The ranges of the secondary electrons are correlated with the mobilities of thermal electrons, as in other liquids. (auth)

2755 E. P. R. STUDY OF γ-IRRADIATED SINGLE CRYSTALS OF $K_2Cr_2O_7$. Krishnamurthy, M. V. (Bhabha Atomic

Research Centre, Bombay). J. Phys. Chem. Solids; 35: No. 4, 606-608(Apr 1974).

Results are reported of an EPR study of gamma-irradiated single crystals of potassium dichromate. Experimental details are given. The strong spectral lines are identified as due to CrO_4^{3-} ion formed as a result of irradiation of $Cr_2O_7^{2-}$ ion. Conclusions are drawn on molecular and crystal structure, and on the electronic structure of the Cr^{5+} occurring in the CrO_4^{3-} ion. (UK)

2756 EFFECT OF GAMMA RADIATION ON ION EXCHANGE RESINS. VI. Kinetics and Mechanism of Radiation Damage of Functional Groups in the Anion Exchange Resin Imac S5-40. Litowska, M.; Narebska, A.; Ostrowska, J. (Univ., Torun, Poland). Nukleonika; 19: No. 1, 21-31(1974). (In Polish).

A kinetic analysis of the radioinduced chemical changes proceeding in the functional groups of the anion exchange resin Imac S5-40 : OH^- was performed. Differential equations describing rates of the separate radiation processes in the irradiated resin are proposed. The rate constant of the straight decomposition of the strong base anion exchange groups, their degradation to weak base groups and decay of amine groups were determined. Using these constants an interpretation of the so-called deamination and degradation curves is given. (auth)

2757 MASS-SPECTROMETRIC APPROACH TO THE DETERMINATION OF THE STRUCTURE OF THE PRODUCT FROM IRRADIATION OF 2,5-DIMETHYL-3,4-DIPHENYLCYCLOPENTADIENE DIMER. Fuchs, B.; Pasternak, M. (Tel Aviv Univ., Israel). J. Chem. Soc., Chem. Commun.; No. 6, 206-207(20 Mar 1974).

The structure of the symmetric irradiation product of 2,5-dimethyl-3,4-diphenylcyclopentadiene dimer was elucidated by mass spectrometry. It is of symmetry C_{2v}. A new technique for the preparation of β-deuterated ketones is described. (auth)

2758 ELECTRICAL CONDUCTIVITY OF SOME IRRADIATED ORGANIC MATRICES AT LOW TEMPERATURES. Kroh, J.; Mienska, M. (Technical Univ., Lodz, Poland). Nukleonika; 19: No. 1, 13-20(1974).

The temperature-current relations were studied for several matrices frozen at 77°K and subjected to the action of ^{60}Co gamma rays. The matrices investigated were methanol, methanol +5 mole % H_2O, and acetone. The results obtained for unirradiated systems indicate the occurrence of phase transitions, in accordance with the results of measurements by x-ray diffraction analysis. The measured temperature-current curves exhibited satisfactory correlation with the results of RTL and ESR investigations. (auth)

2759 TEMPERATURE DEPENDENCE OF ELECTRON SCAVENGING IN LIQUID NON-POLAR HYDROCARBONS. Yakovlev, B. S.; Goriev, I. A.; Balakin, A. A. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 6: No. 1, 23-31(Feb 1974).

The temperature dependence of the excess electron mobility (u) and electron scavenging rate constant (k) of solutions of pyrene in hexane and cyclohexane were measured. They were obtained by investigations of the decay kinetics of electron-pulse-induced conductivity of such solutions in the temperature range 190 to 340°K and 280 to 340°K, respectively. The rate constant k decreases with reduction of temperature, first decreasing slower than the electron mobility u, then becoming proportional to u. The results obtained are compared with the predictions of the following mechanisms of electron migration and scavenging: the observed value of the mobility u is the mean mobility of quasi-free and localized electric states: scavenging of either the quasi-free or the localized electron takes place. It is concluded that electron scavenging processes mostly involve the localized electron. Assuming a contact mechanism for the reaction between scavenger molecule and localized electron, and the validity of diffusion concepts for electron migration, 17 Å and 13 Å are obtained, respectively, for the reaction distance between electron and scavenger and for the radius of the localized electron. (auth)

2760 GAMMA-IRRADIATION INDUCED CHAIN REACTIONS: KINETICS AND MECHANISM OF FORMATION AND DECOMPOSITION OF CYCLOHEXYLTRICHLOROFLUOROETHYL RADICALS. Mey-Marom, A. Tel Aviv, Israel; Tel Aviv Univ. (1973). 82p. (In Hebrew).

Thesis.

Radyolitic techniques were used to induce free radicals addition reactions in solutions of C_2Cl_3F in cyclohexane (RH). The kinetics and mechanism of the addition reaction of cyclohexyl radical to C_2Cl_3F, and other propagation steps of the chain reaction were studied. Rate constants ratios and rate constants were determined over the temperature range 87.5 to 200°C, for the following reactions: (2a) $c\text{-}C_6H_{11} + C_2Cl_3F \rightarrow c\text{-}C_6H_{11}CClFCCl_2$; (2b) $c\text{-}C_6H_{11} + C_2Cl_3F \rightarrow c\text{-}C_6H_{11}CCl_2CClF$; (3a) $c\text{-}C_6H_{11}CClFCCl_2 \rightarrow c\text{-}C_6H_{11}CF = CCl_2 + Cl$; (4a) $c\text{-}C_6H_{11}CClFCCl_2 + c\text{-}C_6H_{12} \rightarrow c\text{-}C_6H_{11}CClFCCl_2H + c\text{-}C_6H_{11}$. The following rate expressions were obtained: $\log k_{2a}(mole^{-1} \cdot l \cdot sec^{-1}) = (8.64 \pm 0.35) - (6.38 \pm 0.41)/\theta^*$; $\log(k_{2b}/k_{2a}) = (-0.03 \pm 0.15) - (2.39 \pm 0.28)/\theta^*$; $\log(k_{3a}/k_{4a})$ $(mole \cdot l^{-1}) = (6.17 \pm 0.10) - (10.14 \pm 0.18)/\theta^*$. In competitive experiments in ternary solutions of C_2Cl_4 and C_2Cl_3F in cyclohexane rate constant ratio k_{2c}/k_{2a} was determined: (2c) $c\text{-}C_6H_{11} + C_2Cl_4 \rightarrow c\text{-}C_6H_{11}C_2Cl_4$, $\log(k_{2c}/k_{2a}) = (0.13 \pm 0.06) - (1.20 \pm 0.12)/\theta^*$. Utilizing previous data from this laboratory for the addition of cyclohexyl radicals to other chloroethylenes it is shown that in certain cases the trends in activation energies for cyclohexyl radical addition to chloroolefins can be correlated with the C-Cl bond dissociation energies in the adduct radicals. $\{^*\theta = 2.303\ RT$ in units of Kcal $\cdot$ mole$^{-1}\}$ (auth)

2761 MECHANISM OF THYMINE FORMATION FROM THYMINE GLYCOL BY γ IRRADIATION IN AQUEOUS SYSTEM. Hayashi, T.; Namiki, M. (Nagoya Univ., Japan). Int. J. Radiat. Biol.; 25: No. 3, 235-244(Mar 1974).

To elucidate the mechanism of the reverse reaction from thymine glycol to thymine in aqueous solution by γ-irradiation, the effects of oxygen, pH, and various scavengers were studied. These results indicate that the reaction was due principally to hydrated electrons. This was also demonstrated by the reaction of thymine glycol with chemically produced electrons. The rate constant of the reaction with hydrated electrons was estimated by the competition method. ESR studies in ethylene glycol glass suggested the presence of the anion intermediate. A reaction mechanism involving disproportionate processes in thymine formation was proposed. (auth)

2762 DIMERIZATION OF THYMINE GLYCOL AND THE SPLITTING OF THE DIMER BY γ-IRRADIATION IN AN AQUEOUS SYSTEM. Hayashi, T.; Ogiso, O.; Namiki, M. (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 46: No. 1, 3896-3898(Dec 1973).

An aqueous solution of thymine glycol was irradiated with gamma rays in the presence of N_2O to eliminate the action of hydrated electrons on thymine glycol. When the irradiated solution was concentrated and chromatographed, a colorless crystalline product was obtained. The structure of the compound was studied. (LK)

2763 METHOD OF MODIFYING POLYMERIC MATERIALS WOOD AND ARTICLES MADE THEREFROM BY RADIATION-INITIATED GRAFT COPOLYMERIZATION THEREOF. Kabanov, V. Y.; Yoronkov, N. A.; Kochkin, D. A.; Spitsyn, V. I.; Kazamanova, I. V. (to Inst. of Physical Chemistry, Academy of Sciences). Canadian Patent 910,233. 19 Sep 1972.

Plastics, such as films of polyethylene, polypropylene, nylon (polycaprolactam), polyester (poly-ethylenegycol-terephthalate) and polyvinyl chloride, or wood, or plastic impregnating wood, can be stabilized against ultraviolet light or protected against fungi (in the case of wood) by graft-copolymerization of triethylmethacryloxystannane "modifier". The grafting, initiated by gamma radiation, is continued until at least 0.5% of modifier has been incorporated. The irradiation can be done either before or after immersing the plastic films, blocks of wood, or other samples, in a deaerated solution of the modifier. (NDH)

2764 ENDOR DETECTION OF PROTON CONFIGURATION AT AN $HAsO_3^-$ RADICALS IN ANTIFERROELECTRIC ADA. Gaillard, J.; Gloux, P.; Lamotte, B. (CEN, Grenoble, France). Solid State Commun.; 14: No. 5, 417-420(1 Mar 1974).

An $HAsO_3^-$ radical has been identified by proton ENDOR in the antiferroelectric phase of the ADA ($NH_4H_2AsO_4$) crystal after room temperature gamma irradiation. The observation of hyperfine interactions for protons surrounding the radical provides a way for studying the hydrogen bonds linked with the radical. The proton positions at the radical sites are found to correspond to "lateral" Slater configurations in agreement with the antiferroelectric ordering of protons in the bulk crystal proposed by Nagamiya [Progr. Theor. Phys. Japan 7, 275 (1952)]. (auth)

2765 PULSE RADIOLYSIS OF LIQUID DEUTERATED AMMONIA. Seddon, W. A.; Fletcher, J. W.; Jevcak, J.; Sopchyshyn, F. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 51: No. 22, 3653-3661(15 Nov 1973). (AECL-4621).

Pulse radiolysis of solutions of alkali metal amides in deuterated ammonia at -15°C produces an initial absorption with a maximum at 1500 nm due to the solvated electron. It decays

on a microsecond time scale, giving a residual long-lived absorption with a slightly broader spectrum and a maximum displaced to 1640 nm. The authors suggest that the residual absorption is due to an equilibrium mixture of solvated electrons and a metal-electron species. The initial decay of solvated electrons can be suppressed by added dissolved deuterium (1 atm) or sodium borohydride (which act by forming ND_2 or $\dot{N}D^-$ radicals), or both. Evidence is also obtained for the formation of solvated electrons, radicals and deuterium. Some constants and G values are quoted. (CA)

2766 EFFECT OF ELECTRON SCAVENGER ON THE γ-RADIOLYSIS OF GASEOUS PROPANE AT HIGH DENSITIES. Nishikawa, M.; Yamaguchi, Y.; Fujita, K.; Kon, K.; Okamota, T. (Tokyo Univ.). Can. J. Phys.; 51: No. 23, 3966-3969(1 Dec 1973).

Hydrogen formation from γ-radiolysis of gaseous propane at 120 ± 1°C was studied as a function of density in the range from 0.1 to 0.5 g/ml. $G(H_2)$ gradually decreased with density from 8.0 at 0.12 g/ml towards the liquid-phase value of 6.4 at room temperature. $G(H_2)$ in the presence of SF_6 showed similar decrease from 3.9 to 3.0. The decrease is compared with the abrupt drop in G-values in the radiolysis of ammonia. The separation distances of ion-electron pairs are estimated from an analysis of the electron scavenging reaction. (auth)

2767 INFLUENCE OF TEMPERATURE AND ELECTROLYTE IONS ON THE PROPERTIES AND SPECTRUM OF SOLVATED ELECTRONS IN IRRADIATED HEXAMETHYLPHOSPHORTRIAMIDE. Mal'tsev, E. I.; Vannikov, A. V. Radiat. Eff.; 20: No. 3, 197-205(Nov 1973).

Pulse radiolysis methods (50 nsec and 2.5 μs pulse durations) with simultaneous optical and electrical registration have been used in a study of temperature influence on mobility and reactions of the solvated electrons in hexamethylphosphortriamide (HMPA). Transient optical absorption spectra in HMPA were studied. A spectrum of e^-_{solv} in pure HMPA was observed up to 2000 nm. Activation energies of e^-_{solv} mobility, salt ions mobility (NaBr) and diffusion-controlled reaction between e^-_{solv} and induced acceptor (Cu^{2+}) in HMPA were determined (1.6; 5 and 1.8 kcal/mole respectively). The reaction mechanism and migration process of e^-_{solv} are discussed on the basis of the results obtained. (auth)

2768 MOLECULE CHARGE TRANSFER REACTION IN LIQUID CYCLOHEXANE. Novikova, L. I.; Ametov, K. K.; Yakovlev, B. S. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 6: No. 1, 15-22(Feb 1974). (In Russian).

Luminescence (L) and electroconductivity (I) induced by pulsed electron radiation of pyrene (A) solutions in cyclohexane were investigated at room temperatures. The part of the luminescence which is due to recombination (L^D_u) of positive and negative A ions was elucidated from the comparison of the time dependences of L and I. On the basis of concentration and time dependences L^D_u the rate constant of the charge transfer reaction $M^+ + A \rightarrow A^+ + M$ was evaluated, $k = (4 + 2) \times 10^{10}$ dm^3 mol^{-1} s^{-1}, where M stands for the cyclohexane molecule. (auth)

2769 RADIATION POLYMERIZATION OF MONOMER-IMPREGNATED SOUTH AFRICAN TIMBERS. Basson, R. A.; Tanewski, E. Z. (Atomic Energy Board, Pretoria). S. Afr. J. Sci.; 68: No. 9, 248-252(Sep 1972).

The need for new markets for local pine varieties and styrene has motivated the development of wood-plastic composites with properties superior to those of the untreated woods. A series of pilot experiments has been conducted on timber samples impregnated with various monomers, which were then polymerized by exposure to radiation. Substantially improved mechanical and weathering properties of the composites compared with the raw material resulted from this treatment, which can, however, only expect wider application if present production results are reduced. (INIS)

2770 γ-RADIOLYSIS OF ETHANE. 3. The Effect of Density on Ion Scavenging Reactions Above the Critical Temperature. Holland, P. T.; Stone, J. A. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 52: No. 2, 221-230(15 Jan 1974).

The radiolysis of ethane was studied over the density range 0.0018-0.5 g cc^{-1} at a temperature just above the critical point. The variations of product yields with increasing density are consistent with increasing collisional stabilization of excited species. Electron scavenging by sulfur hexafluoride in ethane at 0.275 g cc^{-1} is accurately described by an expression used for liquid phase scavenging with $G_{free\ ions} = 0.65$. At 0.052 g cc^{-1} a much higher yield of free ions is observed and at high sulfurhexafluoride concentrations there is a sensitized decomposition of ethane. Ammonia-d3 scavenges ions at all densities but in the region around 0.07 g cc^{-1} a mechanism operates which produces more than one hydrogen molecule per ion scavenged. The freely diffusing ions do not appear to be readily scavenged by ammonia-d_3. (auth)

2771 PULSE RADIOLYSIS OF ALKALI METAL SOLUTIONS IN ETHYLAMINE. Fletcher, J. W.; Seddon, W. A.; Sopchyshyn, F. C. (Chalk River Nuclear Labs., Ont.). Can. J. Phys.; 51: No. 17, 2975-2986(1 Sep 1973). (AECL-4545).

Pulse radiolysis of solutions of alkali metal ethylamides in ethylamine shows the formation of three distinct species; the solvated electron e^-_s, the alkali metal anion M^-, and a species considered to be the cation-electron pair with stoichiometry M. The three species coexist in equilibrium. Studies of these solutions as a function of temperature, alkali metal concentration, and added complexing agents ("crown" compounds) show that e^-_s and M have distinct absorption spectra with the former having a maximum ≥ 1800 nm. The latter exhibit maxima at 1400 nm for Na and K, ~1400 nm for Cs, and 1600-1700 nm for Li. The corresponding M^- species were observed in sodium potassium, and cesium solutions with absorption maxima at 680, 890, and 1100 nm, respectively. Rate and equilibrium constants for the formation of M and M^- vary markedly with the nature of the alkali metal. Estimates for these constants along with the extinction coefficients for the various species are summarized and compared with data obtained in alkali metal solutions. (auth)

2772 INVESTIGATION OF THE POLYMERS FORMED IN REACTOR IRRADIATED ANILINE AND PYRIDINE. Barakat, M. F.; Abdelkerim, F. M. (Atomic Energy Authority, Cairo). Can. J. Phys.; 51: No. 23, 3860-3865(1 Dec 1973).

In reactor irradiated aniline or pyridine most of the radiocarbon generated by the $^{14}N(n,p)^{14}C$ reaction was found preferentially localized in a polymer-like material, brown in color, frequently lustrous and constituting 15-30% of the initial amount of the irradiated material. This stimulated us to try to obtain an idea about the chemical groupings existing in these highly radioactive materials and thereafter to deduce their possible formation pathways. By comparing the IR spectra of these polymers with those of the corresponding pure compounds it was possible to detect some changes in the spectra on polymerization and consequently it was possible to identify some basic structural groups existing. Based on these findings some polymerization reaction mechanisms have been suggested. In general, polymer formation was assumed to take place through the formation of polymerization centers produced by the rupture of the aromatic rings to give highly unsaturated fragments and radicals. These are capable of adding different radicals and fragments formed in the irradiated material by radiolysis or by the action of energetic recoil atoms. Cross-linking between individual polymer chains was observed. The preferential localization of ^{14}C in the polymer fraction could be attributed to the great capacity of the recoil atoms to form reactive secondary species such as $^{14}CH_3^{\bullet}$, $^{14}CH_2^{\bullet\bullet}$ or $^{14}CH^{\bullet\bullet\bullet}$ which participate in polymer formation. (auth)

2773 PULSE RADIOLYSIS OF PENICILLAMINE AND PENICILLAMINE DISULFIDE IN AQUEOUS SOLUTION. Purdie, J. W.; Gillis, H. A.; Klassen, N. V. (National Research Council of Canada, Ottawa). Can. J. Chem.; 51: No. 18, 3132-3142(15 Sep 1973).

Aqueous solutions of penicillamine (RSH) and penicillamine disulfide (RSSR) were pulse irradiated at several pH's and the ensuing reactions studied. (auth)

2774 ESR STUDY OF THE RADICAL PRODUCTS OF LOW-TEMPERATURE γ-RADIOLYSIS OF ADAMANTANE. Gaponova, I. S.; Shanshiashvili, M. I.; Zedelashvili, E. N.; Ershov, B. G. (Inst. of Physical Chemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 73: No. 2, 365-368(Feb 1974). (In Russian).

An ESR study was made of ion-radical intermediate fragments formed in crystalline adamantane during irradiation with ^{60}Co γ rays at 77°K. It is shown that the ESR spectrum of irradiated adamantane is a superposition of singlet and duplet signals. Ion-radical products corresponding to this spectrum have been identified and their initial radiation yields determined. The mechanism of radiation-chemical transformation is presented on the basis of the data obtained. (auth)

2775 VARIATION IN RIBOFLAVIN CONTENT AFTER IRRADIATION WITH γ RAYS FROM ^{60}Co INDOOR UNIT. Abdel-Wahab, M. F.; Megahed, Y. M.; El-Arab, A. E. (Atomic Energy Establishment, Dokki, Egypt). Isotopenpraxis; 9: No. 10, 355-357(Oct 1973).

The results of this work have revealed that riboflavin content is diminished by irradiation with γ-rays. The more the dose and the longer the time of irradiation the more the effect on riboflavin solution. Addition of other materials as ascorbic acid, starch, and thiourea as radioprotectors to riboflavin solution, caused a decrease in the percentage loss, ranging from 12.5 to 86%. Thiourea

used as protector in a ratio, 1:1–riboflavin:thiourea, gave the best result especially with lower doses of radiation. (auth)

2776 INTERACTION OF A SULFONIC ACID ION EXCHANGE RESIN WITH TRITIATED WATER ON γ-IRRADIATION. Mohorcic, G.; Kramer, V.; Pregelj, M. (Ljubljana Univ., Yogoslavia). Int. J. Appl. Radiat. Isotop.; 25: No. 4, 177-182(Apr 1974).

The effect of ^{60}Co γ-irradiation on the uptake of tritium by Dowex 50W-X10 swollen in tritiated water was investigated. The absorbed dose varied between 60 and 250 Mrad. The quantity of tritium atoms inexchangeably bound to the resin after irradiation was measured. From the known dilution factor of HTO at the maximum degree of swelling the inexchangeable incorporation of hydrogen from water was estimated. The value G(org. H) of 0.52 obtained in this way indicates an order of magnitude for reactions of hydrogen atoms from water with the resin Dowex 50W-X10 in acid form on irradiation in absence of oxygen. At an absorbed dose of 100 Mrad, 0.25 at. % of inexchangeable hydrogen in the resin originates from water. It is suggested that the main points of H-attack could be carbon atoms in the ring which have lost their sulfonic groups. (auth)

2777 RADIATION RESIN CURING PROCESS. Holicky, D. F.; Hall, R. P. (to SCM Corp.). Canadian Patent 914,606. 14 Nov 1972.

Conventional polyester resins tend to have soft surfaces due to inhibition of curing at the surface. Improved thermosetting polyester resins whose surfaces are hardened by means of electron beams are produced by substituting for part (say 50%) of the resin, a copolymer with pendant vinyl sidegroups. The copolymer is preferably based on styrene, and has a molecular weight from 5,000 to 225,000. The pendant vinyl groups are linked to the main chain through ester, ether, urethane, amine, or amide linkages. For example (one example out of 7 given), styrene is made to undergo copolymerization with methylmethacrylate and di(hydroxypropyl) maleate. The resulting polymer has pendant hydroxyl groups, which are converted to pendant vinyl groups by reaction with maleic anhydride. The copolymer is then dispersed in styrene, and mixed with a conventional uncured polyester resin consisting of poly-1,3-propyleneglycol maleate mixed with styrene. (CA)

2778 APPLICATION OF MASS SPECTRAL DATA TO THE RADIOLYSIS OF 2-PROPANOL. Bassan, R. A.; Van der Linde, H. J. (Atomic Energy Board, Pretoria). J. Chem. Soc., Faraday Trans., I; 70: No. 3, 431-435(1974).

The yields of the products in the γ-radiolysis of 2-propanol are reported in the absence and presence of solutes. These yields are correlated with those calculated from a modified mass spectral fragmentation scheme in which all primary fragmentations are intensified at the expense of their further fragments. Good agreement between the experimental and calculated yields is found. (auth)

2779 PROCESS FOR IMPROVING HYDROGENATION CATALYST BY IRRADIATION. Seaman, W.; Stewart, D. Jr. (to American Cyanamid Co.). US Patent 3,803,010. 9 Apr 1974. Filed date 10 Sep 1971. 8p.

A process for the preparation of a hydrogenation catalyst is reported. It is useful in the reduction of aromatic nitro compounds to the corresponding aromatic amine compounds. More particularly, it is a process for preparation of a copper hydrogenation catalyst with improved catalytic activity produced by subjecting the catalytic material to high energy electron radiation until the dosage absorbed by the catalytic material is in the range of from about 0.5 megarad to about 5 megarads. (Official Gazette)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 5126 and 5705.

2780 COEFFICIENTS OF TRACER TRANSFER THROUGH MEMBRANES. Dorabialska, A.; Hawlicka, E.; Pionka, A. (Technical Univ., Lodz, Poland). Nukleonika; 19: No. 1, 65-69(1974).

The doubled value of the tracer transfer coefficient in the self-diffusion process is equal to the sum of tracer transfer coefficients in the diffusion and interfusion processes. From the results presented in the previous papers of this series the fundamental phenomenological relation can be deduced for the coefficients of tracer transfer between two phases of electrolyte solutions separated by a virtual boundary. Indeed, the doubled value of the tracer mobility in the self-diffusion experiment (no concentration gradient of the traced substance) is equal to the sum of the tracer mobilities in the diffusion (tracer movement along with the concentration gradient of the traced substance) and interfusion experiments (tracer movement against the concentration gradient of the traced substance). Thus the doubled value of the tracer transfer coefficient in the self-diffusion process should be equal to the sum of tracer transfer coefficients in the diffusion and interfusion processes. The experimental verification of that fundamental relation is presented. (auth)

Hot-Atom Chemistry

Refer also to abstract 2706.

2781 EFFECT OF ADDITIVES ON THE THERMAL ION REACTION OF ^{80}Br FROM NUCLEAR ISOMER TRANSITION WITH CH_4. Kobayashi, T. (Tohoku Univ., Sendai); Shiokawa, T.; Yagi, M.; Kondo, K. Kakuriken Kenkyu Hokoku; 5: No. 2, 123-136(Dec 1972). (In Japanese).

The effects of various relatively inert additives with different ionization potentials on the yield of CH_3 ^{80}BrBr in the ^{80m}BrBr–CH_4 reaction system were studied in order to prove participation of Br^+ ion in the reaction. Possibility of the production of CH_2 ^{80}BrBr by an ion–molecule reaction was evaluated. Ne, Ar, Xe, CF_4, $CBrF_3$, and CCl_2F_2 were used as additives. ^{80}BrBr was prepared by pyrolysis of $PdBr_2$ irradiated by electron-Bremsstrahlung. No apparent difference was observed in the organic yields or yields of each product (CH_3 ^{80}Br or CH_2 ^{80}BrBr) when a rare gas Ne, Ar, or Xe, or CF_4 was used as an additive when compared to each other or to the ordinary Kr-additive system. In $CBrF_3$-additive and CCl_2F_2-additive systems, however, total organic yields or yields of each fraction containing CH_3 ^{80}Br or CH_2 ^{80}BrBr decreased more rapidly than in the Kr-additive system as the mol. fraction (m.f.) of additive increased. The result was explained in terms of degree of scavenging ability of additives for recoil Br^+ in charge transfer reactions. Since ionization potentials of $CBrF_3$ and CCl_2F_2 are close to that of Br, they showed a high neutralization effect for Br^+. Results also indicated that CH_2 ^{80}BrBr can be produced through exothermic ion–molecule reactions. The first positive circumstantial evidence was obtained for occurrence of thermal ion reactions in the ^{80}BrBr–CH_4 system. (auth)

2782 RELATIVE REACTION RATES INVOLVING THERMAL FLUORINE-18 ATOMS AND THERMAL FLUOROETHYL RADICALS WITH OXYGEN, NITRIC OXIDE, SULFUR DIOXIDE, NITROGEN, CARBON MONOXIDE, AND HYDROGEN IODIDE. Milstein, R.; Williams, R. L.; Rowland, F. S. (Univ. of California, Irvine). Contract AT(04-3)-34. J. Phys. Chem.; 78: No. 9, 857-863(25 Apr 1974).

The reactions of thermal ^{18}F atoms were studied with O_2, NO, SO_2, N_2, and CO in competition with addition to C_2H_2 or C_2H_4. Addition to C_2H_4 is 0.83 ± 0.02 as rapid, and total reaction with SO_2 is 0.04 ± 0.02 as fast as addition to acetylene. The reaction rates with the molecules O_2, NO, N_2, and CO are all <0.01 vs. addition to acetylene, at about 4000 Torr. The relative rates of reaction of $CH_2{}^{18}FCH_2$ radicals with various scavengers are HI, (1.0); NO, 5.0 ± 0.5; O_2, 1.05 ± 0.10; SO_2, 0.33 ± 0.10; CO, 0.005 ± 0.002. For $CH^{18}F$ = CH radicals, the relative rates are HI, (1.0); CO, 0.022 ± 0.007; N_2, <0.003. (auth)

2783 CHEMISTRY OF RECOIL TRITIUM ATOMS. Part 5. Extension of the Estrup–Wolfgang Theory of Hot Atom Reactions to Mixtures of Reactive Components. Johnston, A. J. (North East London Polytechnic); Urch, D. S. J. Chem. Soc., Faraday Trans., I; 70: 369-378(1974).

The Estrup-Wolfgang theory for the analysis of data from hot-atom experiments is extended to include the case of two reactive components. Energy shielding (K) integrals are found which describe the way in which the reactions of one component are affected by the reactions of high energy atoms with the other component. The theory is applied to the system in which recoil tritium atoms react with mixtures (and helium moderated mixtures) of ethylene with propene trans-but-2-ene and isobutene and also ethane with trans-but-2-ene. It is shown that the mean energy of tritium atoms that cause labelling and products derived from addition to the double bond increases in the sequence isobutene, ethylene, propene and trans-but-2-ene. With the exception of isobutene this order is explained by postulating that lower energy recoil tritium atoms can react at an sp^2 site than at an sp^3 site. The proposed extension of the theory would not seem to be suitable for the analysis of the data from the ethane+but-2-ene system. But helium moderated experiments show that both ethane and trans-but-2-ene "shield" each other indicating that the labelling reaction for both is initiated by recoil atoms in a comparable energy range. (auth)

2784 GAS PHASE RECOIL PHOSPHORUS REACTIONS. II. A Detailed Study of Pressure and Scavenger Effects. Gennaro, G. P.; Tang, Y. N. (Texas A and M Univ., College Station). J. Inorg. Nucl. Chem.; 36: No. 2, 259-262(Feb 1974).

Products from recoil phosphorus reactions with PH_3 or PF_3 exhibit no pressure dependence. In the PH_3 system 1,3-butadiene was found to be an effective scavenger probably due to the stabilization of the C-P bond in the scavenged adduct by conjugation. It has also been shown that H-abstraction by recoil ^{32}P atoms from PH_3 is about 160 times more effective than the F-abstraction from PF_3. The upper limit for the complete retention of bonds in PH_3 after radiative neutron capture has been estimated as 4%. (auth)

2785 THERMAL ANNEALING OF ^{60}Co RECOIL ATOMS AT ANIONIC AND CATIONIC SITES IN NEUTRON IRRADIATED CRYSTALS OF cis-$[Cren_2Cl_2][Coglyc_2(NO_2)_2].nH_2O$. Lazzarini, E.; Fantola-Lazzarini, A. L. (Politecnico di Milan). J. Inorg. Nucl. Chem.; 36: No. 2, 263-265(Feb 1974).

The thermal annealing of ^{60}Co recoil species was studied in neutron irradiated crystals of cis-$[Cren_2Cl_2][Coglyc_2(NO_2)_2].nH_2O$. It was found that the ^{60}Co recoil species can anneal not only at anionic sites which are occupied by ^{59}Co target atoms, but also at cationic sites, where Cr atoms are situated. Moreover, the isochronal annealing curves of the ^{60}Co recoil species at the cationic and anionic sites are correlated, that is they have the same number of steps which occur at the same temperatures. These results together with those obtained in previous experiments on Co(III) double complexes and mixed crystals (solid solution) of isomorphous ions, are discussed in terms of the solid-state isotopic exchange model for the annealing of atoms recoiled by Szilard-Chalmers effect. (auth)

Properties of Radioactive Materials

Refer also to abstracts 2558, 2564, 2584, 2595, 2645, 2647, 3479, 3507, 3711, 3807, 3880, 3962, and 4992.

2786 (BARC/I-135, pp 119-128) CHEMICAL DEVELOPMENT WORK ON MOLTEN SALT BREEDER REACTOR CONCEPT. Ramaniah, M. V.; Sood, D. D.; Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Roy, K. N.; Nag, K.; Singh, Z. (Bhabha Atomic Research Centre, Bombay). 1971.

As a part of work to assess the chemical feasibility of plutonium start-up molten salt breeder reactor, investigations on the solubility and stability of PuF_3 in $LiF-BeF_2-ThF_4$ are reported. CeF_3 tagged with ^{144}Ce and PuF_3 were prepared from their oxides by hydrofluorination. The solubility of CeF_3 in $LiF-BeF_2-ThF_4$ (66.5, 19, 14.5 mole %) was determined at 500-800°C as a stand-in for PuF_3 in $LiF-BeF_2-ThF_4$ (68.2, 20.5, 11.3 mole %) was determined in the temperature range of 550 -800°C. The data are tabulated. (INIS)

2787 (CONF-720486-, pp 19-23) PREPARATION OF IODINE-131 INSULIN. Davila, A. T.; Lugtu, C. P. 1972.

From joint annual convention of the radioisotope and nuclear medicine meeting; Quezon City, Philippines (7 Apr 1972).

Insulin labeled with ^{131}I is useful for the immunoassay of endogenous insulin in plasma or other body fluids and the study of the metabolism and action of the unlabeled hormone. Experiments were performed in order to devise a procedure for the labeling of insulin with ^{131}I and the subsequent separation of the inorganic iodine from the labeled product. (auth)

2788 (CONF-720486-, pp 24-30) COMPLEXATION OF TERVALENT AMERICIUM, CURIUM, AND CALIFORNIUM WITH TROPOLONE AND β-ISOPROPYLTROPOLONE. Cilindro, L. G. 1972.

From joint annual convention of the radioisotope and nuclear medicine meeting; Quezon City, Philippines (7 Apr 1972).

The composition and stability of the complexes were determined at 25°C and ionic strength of 0.1. The solvent extraction procedure used enabled the use of only tracer amounts of the metal ions of interest. Distribution curves are shown. The stability constants are higher than for the corresponding 1,3-diketonate chelates; this is attributed to the delocalization of the π orbital system of the aromatic ring of the ligand. (MCG)

2789 (FRNC-TH-484) STUDIES OF THE REDUCING PYROHYDROLYSIS OF URANYL FLUORIDE. Favre, P. (Lyon-1 Univ., 69 (France)). 1973. 75p. (In French). Dep. NTIS (US Sales Only) $6.75.

Thesis.

In the dry process for obtaining UO_2 from UF_6, gaseous UF_6 is hydrolyzed with steam. The UO_2F_2 oxyfluoride thus obtained is reduced to UO_2 with a hydrogen-steam mixture. An installation was developed which enabled the $UO_2F_2 + H_2 \rightarrow UO_2 + 2HF$ reducing pyrohydrolysis reaction to be studied. These studies were carried out by investigating the $UO_2F_2 \rightarrow U_3O_8$ pyrohydrolysis in an inert atmosphere followed by the reduction of UO_3 and U_3O_8 oxides into UO_2. Finally, a reaction mechanism was proposed from studies of the reducing pyrohydrolysis. A thermogravimetric analysis method allowed the changes in the mass of the sample to be investigated during the reaction. A potentiometric method was developed for the determination of fluorine traces in uranium oxides. (FR)

2790 (INIS-mf-887-1, pp 101-108) SELF-DIFFUSION AND COLLOIDAL PROPERTIES OF CERTAIN FISSION PRODUCTS. Kepak, F. (Ustav Jaderneho Vyzkumu, Rez, Czech.). [nd]. (In Czech).

Variations in the self-diffusion coefficients of $^{106}Ru(IV)$, $^{106}RuNO(III)$, $^{144}Ce(III)$, $^{147}Pm(III)$, and $^{155}Eu(III)$ with the solution pH are reported. In addition, the variations in self-diffusion coefficients for $^{106}Ru(IV)$ and RuNO(III) with the ionic strength of the solution were studied. The course of self-diffusion in relation to pH showed that hydroxides of small dimensions and of a colloidal nature were formed. The dependence of ^{85}Sr self-diffusion in the presence of microamounts of Fe(III) or Mn(IV) hydroxides indicated the absorption of radioactive microfractions at extremely low concentrations of the sorbent, as well as the formation of heterogeneous adsorption radiocolloids was possible. Also, the contribution of trace amounts of impurities in a solution to the formation of the AgI sol at extremely low concentrations of I^- and Ag^+ can not be excluded. Thus, the possible formation of the colloid of the dissoluble compound AgI before its coefficient of solubility has been achieved must be considered. (INIS)

2791 (INIS-mf-1001) OXIDATIVE DEMETHYLATION OF TOLUENE WITH BISMUTH URANATE. Steenhof de Jong, J. G. (Technische Hogeschool Delft (Netherlands)). 12 Dec 1972. 111p. INIS.

Toluene, brought in contact with various bismuth uranates in a stream of an inert gas at 400 to 500°C, is oxidized to benzene, CO_2, and H_2O. The highest benzene yields are obtained with the compound Bi_2UO_6 with high specific area. During the reaction bismuth uranate can lose about 67% of its oxygen atoms under formation of metallic bismuth and UO_2. The original activity is completely restored by oxidation with molecular oxygen. This opens the possibility of demethylating toluene by passing air and toluene over bismuth uranate alternatingly. The kinetics of the reduction over bismuth uranate with toluene were investigated in micro-pulse and micro-flow reactors and in a thermobalance. The kinetics of the surface reaction were determined in the pulse system. The reaction proceeds according to a first-order parallel scheme with an activation energy of 30 kcal/mol. In the flow system and in the thermobalance the rate of oxygen diffusion through the lattice also plays a role. The kinetics could be described by an equation that comprised both the chemical reaction and the diffusion. Agreement with the experimental data is good. It appears that bismuth uranate contains two different types of lattice oxygen, a non-selective one with diffusion coefficient $D = 3 \times 10^{-22}$ m^3 s^{-1} and a diffusion activation energy $E = 26$ kcal mol^{-1}, and a more selective one with $D = 3 \times 10^{-20}$ and $E = 63$ (at 470°C). The reaction of bismuth uranate with CO, benzaldehyde, and benzoic acid as well as the pyrolysis of bismuthyl and uranyl benzoates were studied. From the results we concluded that the selective reaction probably proceeds via a benzoate-like intermediate. The activity of a great number of other binary oxides in toluene oxidation was investigated. Promising results were obtained with the bismuth phosphate system. (INIS)

2792 (JINR-P12-7767) PREDICTIONS ON THE BEHAVIOUR OF SUPERHEAVY ELEMENTS AND THEIR CHLORIDES AT THERMOCHROMATOGRAPHIC SEPARATION. Aikhler, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 24p. (In Swedish). Dep. NTIS (US Sales Only) $4.25.

The most probable chemical states of superheavy elements have been established by extrapolating their thermodynamic properties during evaporation in hydrogen or chloride stream. The standard enthalpy of sublimation of these elements and their chlorides has been estimated. The results obtained are discussed from the viewpoint of the possible thermochromatographic separation of nuclear reaction products. It is shown that, in principle, the possibility exists of selective separation of elements 112-117 in hydrogen stream. (auth)

2793 POLAROGRAPHIC BEHAVIOR OF URANYL IONS IN THE PRESENCE OF PYRIDINE AND HYDRAZINE. Almagro,

V.; Garcia, F. S.; Sancho, J. (Univ. Autonoma, Madrid). Anal. Chim. Acta; 70: 237-240(1974).

The characteristics of the uranyl polarographic wave in pyridine and hydrazine media were studied, and the ionic species formed are described. (LK)

2794 LOADING A CATION EXCHANGE RESIN WITH URANYL IONS. Haas, P. A. (to United States Atomic Energy Commission). US Patent 3,800,023. 26 Mar 1974. Filed date 16 May 1972. 8p.

A method for loading ion exchange resins is described. The process comprises contacting a cation exchange resin with a uranyl nitrate salt solution which is acid deficient. (Official Gazette)

2795 PREPARATION OF BIOLOGICALLY ACTIVE ^{125}I-LABELED ADRENOCORTICOTROPHIC HORMONE BY A SIMPLE ENZYMIC RADIOIODINATION PROCEDURE UTILIZING LACTOPEROXIDASE. McIlhinney, J.; Schulster, D. (Univ. of Sussex, Brighton, Eng.). Endocrinology; 94: No. 5, 1259-1264(May 1974).

Adrenocorticotrophic hormone (ACTH) was radiolabeled by a method utilizing the enzyme lactoperoxidase. The ^{125}I labeled hormone so prepared retained between 50 and 55% of its biological activity as assayed using isolated adrenal cells, and had dose-response characteristics identical with native ACTH over the range 10^{-11} to 10^{-6} g in this bioassay system. Specific activities of up to 600 μCi/μg have been attained using this method. The ^{125}I-labeled hormone was found to be of high purity following CM-cellulose chromatography and gel-electrophoresis. Sequential Edman degradation of the labeled hormone showed that the position of the iodine atom was predominantly (>80%) on the tyrosine at position two in the ACTH molecule. (auth)

2796 SPECTRAL STUDIES OF OXOURANIUM(V) SPECIES. Selbin, J.; Sherrill, H. J. (Louisiana State Univ., Baton Rouge). Inorg. Chem.; 13: No. 5, 1235-1239(May 1974).

Electronic spectral studies and semiempirical theoretical calculations of energy levels of UOF_5^{3-} and $UOBr_5^{3-}$ were made in order to locate and assign all of the six electronic transitions in these $5f^1$ species. The data are compared with previous results for $UOCl_5^{3-}$ and reveal that each of the six electronic transitions is shifted to higher energy in the expected order: $Br^- < Cl^- < F^-$. The best-fit spin-orbit coupling constants also increase in this same order: 1750, 1770, and 1850 cm^{-1}, respectively. Electron paramagnetic resonance spectra were obtained for polycyrstalline solids at ambient temperature for all species UX_6^- and UOX_5^{3-} (X^- = F^-, Cl^-, Br^-) except for UF_6^-. The significance of these EPR results is discussed. (auth)

2797 SOLVENT EXTRACTION PROCESS FOR PRODUCING LOW-NITRATE AND LARGE-CRYSTAL-SIZE PuO_2 SOLS. Lloyd, M. H. (to United States Atomic Energy Commission). US Patent 3,794,715. 26 Feb 1974. Filed date 30 Aug 1972. 10p.

Low-nitrate plutonia sols having a NO_3/Pu mole ratio in the range 0.1 to 0.4 with an average crystallite diameter of 30 to 80 A can be produced when a sol is prepared by solvent extraction of a plutonium nitrate seeded with a plutonia sol. When the seeded sol is taken to dryness and heated for 10 to 120 minutes at a temperature in the range 180 to 230°C in a dry sweep gas, nitrate removal occurs and the baked solid can easily be dispersed to form a stable sol. (Official Gazette)

2798 STEPWISE FORMATION CONSTANTS OF Co(II), Ni(II), Cu(II), Zn(II), Cd(II), AND UO_2(II) CHELATES OF THE SCHIFF BASE FROM BENZOYLACETONE AND BETA-ALANINE. Mehta, R. K.; Pania, S. L.; Gupta, R. K. (Univ. of Jodhpur, India). Indian J. Chem.; 11: No. 10, 1073-1074(Oct 1973).

Protonation constants of the Schiff base derived from benzoylacetone and β-alanine, and the formation constants of its chelates with bivalent metal ions were determined potentiometrically in 50% (vol./vol.) dioxane solutions (μ = 0.1 *M* $NaClO_4$) at 30° ± 0.1°C. The order of stability constants, UO_2 > Cu > Ni ≅ Co > Zn > Cd, is found to be in agreement with the Irving and Williams rule. The overall free energy change at 30°C is 26.20, 24.78, 19.34, 20.65, 16.79 and 13.18 kcal/mole for UO_2(II), Cu(II), Ni(II), Co(II), Zn(II) and Cd(II) complexes respectively. (auth)

2799 DIARYLDITHIOPHOSPHINATO COMPLEXES OF OXOVANADIUM(VI) AND DIOXOURANIUM(VI). Mukherjee, R. N.; Shanbhag, S. V.; Venkateshan, M. S.; Zingde, M. D. (Indian Inst. of Tech., Powai, India). Indian J. Chem.; 11: No. 10, 1066-1067(Oct 1973).

Diaryldithiophosphinato complexes of VO(IV) and UO_2(VI) were prepared and their ir and electronic spectra and magnetic moments were recorded. The results are consistent with the pentacoordinate and hexacoordinate geometries for vanadium and uranium complexes respectively. The complexes are soluble in organic solvents and substitution in the benzene nucleus attached to phosphorus does not influence the spectrochemical properties of the complexes. (auth)

2800 DETERMINATION OF THE RADIOCHEMICAL PURITY OF FORMIC ACID-^{14}C, ACETIC ACID-1-^{14}C, AND ACETIC ANHYDRIDE-1,1-$^{14}C_2$ BY RADIO GAS CHROMATOGRAPHY. Sokolowska, A. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 17: No. 2, 95-103(20 Apr 1974).

The application of radio gas chromatography for the determination of radiochemical purity of formic and acetic acids and acetic anhydride labeled with ^{14}C is described. Quantitative results are based on the radioactivity measurements carried out in a proportional, flow window counter. (auth)

2801 PRODUCTION OF FLUORINE-18 LABELED 5-FLUOROURACIL. Fowler, J. S.; Lambrecht, R. M.; Wolf, A. P. (to United States Atomic Energy Commission). US Patent 3,808,097. 30 Apr 1974. Filed date 28 Nov 1972. 4p.

A method of producing radioactive 18-labeled 5-fluorouracil involves of bombarding gaseous neon containing stable fluorine with a beam of deuterons to produce ^{18}F, passing the resulting gas mixture through a solution of uracil in trifluoroacetic acid until all of the former has reacted with fluorine, and evaporating the reacted solution to produce a solid residue followed by subliming the residue to recover the labeled 5-fluorouracil as the sublimate. (Official Gazette)

2802 KINETICS AND MECHANISMS OF THE OXIDATION OF URANIUM(IV) WITH SODIUM PERSULFATE. Manok, F.; Varhelyi, C.; Oprean, R. (Univ., Cluj). Rev. Roum. Chim.; 19: No. 3, 407-413(Mar 1974).

The kinetics of the oxidation of $U(SO_4)_2$ solutions in acid medium with sodium persulfate was investigated. The variation of the U(IV) concentration was followed by permanganate titration at 23, 30, and 40°C. $\Delta H^{\ddagger}$ = 27.4 kcal/Mol was obtained for the activation enthalpy and $\Delta S^{\ddagger}$ = +23.1 Cl for the activation entropy. In the presence of very small amounts of Fe(II) the reaction was significantly accelerated. A probable mechanism for the oxidation process was discussed on the basis of the experimental data. (tr-auth)

2803 PREPARATION OF URANIUM TETRACHLORIDE. Wilson, P. W. (Australian Atomic Energy Commission, Sutherland). Syn. Inorg. Metal-Org. Chem.; 3: No. 4, 381-385(1973).

A method is described of preparing UCl_4, based on the interaction of UO_3 with CCl_4, that is satisfactory for laboratory scale preparations. (auth)

2804 METHOD OF PREPARING URANIUM DIOXIDE POWDER. Vietzke, H.; Ploeger, F.; Wegner, K.; Pirk, H. (to Nuklear-Chemie und -Metallurgie GmbH). Canadian Patent 933,336. 11 Sep 1973.

Ammonium uranyl carbonate is precipitated by adding UF_6 + CO_2 to a precipitation vessel through one mixer nozzle and ammonia through another mixer nozzle, the temperature of the solution being maintained below 70°C and the pH in the range 7.8 to 8.6. The suspension from the precipitation may pass to a cooling vessel before filtration. (Precipitation from an equivalent solution of uranyl nitrate may be achieved similarly). The precipitate is decomposed and reduced with rapidly passed steam plus hydrogen in a fluidized bed at 500 to 600°C (preferably two stages are used, the first being at 300°C). Finally, the uranium dioxide is treated with steam and air at 600°C to render it hyperstoichiometric in oxygen and non-pyrophoric. (CA)

2805 STUDY ON THE ADSORPTION BEHAVIOR OF IGNITED LEAD FLUORIDE TOWARDS ^{32}P. Bhutani, M. M. (Indian Inst. of Tech., New Delhi). Radiochem. Radioanal. Lett.; 17: No. 1, 55-60 (10 Apr 1974).

The behavior of ignited lead fluoride towards adsorption of tracer phosphate ions was studied radiometrically in the presence of lattice as well as nonlattice ions. The influence of pH and that of the various lattice and nonlattice ions is compared and discussed in the light of the behavior observed with lead sulfate. The variation in the results is explained in terms of the structural characteristics and isomorphous behavior of various compounds involved. (auth)

2806 STABILIZATION OF ORGANIC RADIOIODINE COMPOUNDS. Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf). Radiochem. Radioanal. Lett.; 17: No. 1, 21-24(10 Apr 1974). (In German).

Compounds labeled with radioactive iodine generally give off iodine ions. They can be stabilized against water, weakly alkaline solutions, and moderate temperature rises by the addition of organic amines. (auth)

2807 CHEMISTRY OF GALLIUM. VIII. Coprecipitation of Gallium(III) with Zinc Sulfide. Rafaeloff, R. (Soreq Nuclear Research Centre, Yavne, Israel). Radiochem. Radioanal. Lett.; 17: No. 1, 15-19(10 Apr 1974).

Radiochemical methods were used to determine whether gallium coprecipitates with zinc sulfide from alkaline solutions. It was found that they coprecipitate isomorphously. (auth)

2808 SPECTROSCOPIC PROPERTIES OF INORGANIC AND ORGANOMETALLIC COMPOUNDS. A Review of the Literature Published During 1972. Volume 6. Greenwood, N. N. London; Chemical Society (1973). 678p.

A comprehensive review is presented of literature published during 1972 on the NMR, NQR, microwave, vibrational and Moessbauer spectra of inorganic and organometallic compounds. Sections of particular interest to nuclear technology are (1) vibrational spectra of the actinides; and (2) Moessbauer spectroscopy of the lanthanide and actinide elements. (UK)

2809 RECOIL ENERGY MIGRATION OF RADON ATOMS IMPLANTED IN CRYSTALS. Lambert, G.; Bristeau, P. (CNRS, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 137-138(1973). (In French).

Simple radioactivity measurements were used to demonstrate that the diffusion of radon inside monocrystals and various minerals is very small and that this fact cannot be explained by the emanating power of the rocks. (FR)

2810 CRYSTAL STRUCTURE OF URANYL CHLORIDE-BIS-TRIETHYLAMMONIUM CHLORIDE. Brusset, H.; Nguyen-Quy-Dao; Haffner, F. (Ecole Centrale des Arts et Manufactures, Chatenay-Malabry, France). J. Inorg. Nucl. Chem.; 36: No. 4, 791-794(Apr 1974).

The structure of $UO_2Cl_2 \cdot 2[(C_2H_5)_3NHCl]$ was determined from three-dimensional single-crystal x-ray data. Space group is $I4_1/a$ with unit cell dimensions a = 13.55 Å(5), c = 24.32 Å(5). The measured and calculated densities are, respectively, 1.79(5) and 1.84 g/cm^3 for eight molecules per unit cell. The uranium atom has octahedral coordination in the $UO_2Cl_4^{2-}$ anion, with four chloride atoms at the corners of a rectangular plane while the uranyl group UO_2^{2+} is linear and almost perpendicular with regard to the rectangular plane. The approximate symmetry of the ion is D_{4h}. The chains $(C_2H_5)_3NH$ are very similar to those which are found in the structure of triethylammonium chloride. The cohesion in the molecule $UO_2Cl_2 \cdot 2[(C_2H_5)_3NHCl]$ is assured by weak hydrogen bonds N...H...Cl of length 3.6(1) Å. Two of the four chlorine atoms are linked to the nitrogen. (auth)

2811 RADIOPHARMACEUTICALS LABELLED WITH RADIOACTIVE MERCURY. Preparation and Investigation of Correlations Between Chemical Structure and Organ Affinity. I. The Pharmacological and Chemical Bases. Herzmann, H. (Zentralinstitut fuer Isotopen-und Strahlenforschung, Berlin). Isotopenpraxis; 9: No. 10, 349-355(Oct 1973). (In German).

Organic preparations labelled with radioactive mercury are of great importance for nuclear diagnostics, especially for static kidney scintigraphy. The criteria of the development of nuclear pharmaceuticals having been discussed, the pharmacology and the biochemistry of pharmaceuticals containing mercury are being considered. The preparations Chlormerodrin and Mersalyl are used for models to show the possibilities of syntheses providing variation of chemical structure and, thus, of pharmacokinetics. Finally, oxymercuration of olefines is briefly being described. (auth)

2812 DEACTIVATION PATHWAYS OF EXCITED URANYL IONS IN SOLUTIONS. Sergeeva, G.; Chibsov, A.; Levshin, L.; Karyakin, A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). J. Chem. Soc., Chem. Commun.; No. 5, 159-160 (6 Mar 1974).

Deactivation pathways of excited uranyl ions in solutions have been studied by flash photolysis and the production of U^{5+} has been shown to occur via exciplex formation as a result of donor-acceptor interaction between U^{6+*} and electron donors. (auth)

2813 STUDIES ON ACTINIDE ELEMENTS. VI. Photochemical Reduction of Uranyl Ion in Citric Acid Solution. Ohyoshi, A.; Ueno, K. (Kumamoto Univ., Japan). J. Inorg. Nucl. Chem.; 36: No. 2, 379-384(Feb 1974).

The photochemical reduction of uranyl ion in citric acid solutions was studied in the presence of visible light. The rate of the reduction was found to be: rate = $k_{obs}[UO_2^{2+}]$, where k_{obs} is the apparent rate constant. The value of k_{obs} was 1.63×10^{-2} min^{-1} at $[UO_2^{2+}]$: 9.5×10^{-3}M, [citric acid]: 4.8×10^{-2}M, pH 3.1, 30°C, and 4050 to 4360 Å light irradiation. The quantum yield for U(IV) formation varied with the hydrogen-ion concentration of reaction medium from 0.03 (pH 1.0) to 0.99 (pH 3.5). The oxidation products of citric acid were identified to be acetone and carbon dioxide. The reaction seems to proceed predominantly through the intramolecular decomposition process of uranyl-citrate complex, i.e. $[UO_2H_3L]^+ + h\nu \rightarrow [UO_2H_3L]^{+*} \rightarrow U(V) + CO_2 +$ ketocarboxylic acid, and ketocarboxylic acid $\rightarrow$ acetone + $2CO_2$. This mechanism is different from those that involve two competing mechanisms in the case of uranyl-lactic acid system. This may be interpreted by assuming that the uranyl citrate is more stable than lactato complex and it forms a chelate ring to efficiently dissipate the absorbed photon energy. (auth)

2814 PREPARATION AND PROPERTIES OF URANIUM OXIDE TETRAFLUORIDE. Wilson, P. W. (Australian Atomic Energy Commission Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 2, 303-305(Feb 1974).

Uranium oxide tetrafluoride has been prepared. This is the first preparation of an actinide element oxide tetrahalide. It was formed by the hydrolysis of UF_6 suspended in a HF slurry. It is an orange, hygroscopic powder. A number of its physical and chemical properties have been determined, the most interesting of which is its thermal decomposition. Heating UOF_4 to 500°C produces UO_2F_2 and UF_6, but at lower temperatures an intermediate is formed which may be $U_2O_3F_6$. In contrast to other metal oxide tetrafluorides, UOF_4 is not volatile at temperatures below its decomposition point. (auth)

2815 INHIBITING ACTION OF THALLIUM(I) ION ON URANYL PHOTOREDUCTION. Yokoyama, Y.; Moriyasu, M.; Ikeda, S. (Osaka Univ.). J. Inorg. Nucl. Chem.; 36: No. 2, 385-389(Feb 1974).

The reaction rate of uranyl photoreduction in lactic acid solution is decreased in the presence of small amounts of thallium(I) ion. The inhibiting action of thallium(I) ion obeys the Stern-Volmer equation. The reaction mechanism of the uranyl photoreduction and the inhibiting action has been investigated in correlation with quenching of uranyl fluorescence. The results are: (1) In 1 N sulfuric acid, lactic acid quenches the uranyl fluorescence by collision and simultaneously initiates the uranyl photoreduction. (2) Inhibiting action of thallium(I) ion is also collisional. The collisional process is diffusion-controlled, having a rate constant of 5.2×10^9M^{-1} sec^{-1} at 22°C. (3) Quenching by paramagnetic ions is not so significant compared with heavy metals. (auth)

2816 COMPOUNDS OF RARE EARTH ELEMENTS WITH α-FUROINOXINE. Pastorek, R. (Palackeho Univ., Olomouc, Czech.). Monatsh. Chem.; 104: No. 3, 901-917(May 1973). (In German).

Compounds of the general composition $LnCl_3 \cdot 3H_2Fox$ (Ln = La, Ce, Pr, Nd, Sm, Eu) were isolated. They were investigated by means of thermoanalysis, IR spectroscopy and x-ray diffraction. Molar conductivity measurements in methanol confirmed the 1:1 composition-$[Ln(H_2Fox)_3Cl_2]Cl$-corresponding to a coordination number eight. (auth)

2817 PREPARATION OF ADENOSINE-5-MONOPHOSPHATE-[8-^{3}H] WITH HIGH MOLAR ACTIVITY. Bohacek, L.; Filip, J. (Ustav pro Vyzkum, Vyrobu a Vyuzti Radioisotopu, Prague). Radioisotopy; 14: No. 5, 783-799(1973). (In Czech).

The synthesis of adenosine-5'-monophosphate-[8-^{3}H] with a molar activity greater than 10 Ci/mmole and radiochemical purity better than 95% is described. The catalytical reductive dehalogenation of 8-bromoadenosine-5'-monophosphate was studied and it was found in tracer experiments that the highest molar activities can be obtained with the use of 1 N potassium or ammonium hydroxide. The dependence of the isotopic exchange of hydrogen in the system adenosine-5'-monophosphate : solvent : water was investigated. Dimethyl formamide and hexamethyl phosphotriamide were used as solvents. With hexamethyl phosphotriamide 42.3% of the theoretical molar activities were obtained in tracer experiments. The pH dependence of the isotopic hydrogen exchange in adenosine-5'-monophosphate-[8-^{3}H] in aqueous medium (100°C, 1h) was studied. The isotopic hydrogen exchange is considerably accelerated in alkaline medium. (auth)

2818 KINETICS OF THE DISCHARGE OF THORIUM(IV) IN PRESENCE OF ETHYLENEBIS(3-MERCAPTOPROPIONATE) AT THE DROPPING MERCURY ELECTRODE. Saxena, R. S.; Chaturvedi, U. S. (Malaviya Regional Engineering Coll., Jaipur, India). Monatsh. Chem.; 104: No. 5, 1203-1207(Sep 1973). (In German).

The reduction of thorium at the dropping mercury electrode in presence of ethylene bis(3-mercaptopropionate) was found to be

irreversible and kinetically controlled. The kinetics of the electrode reaction has been investigated adopting the treatment followed by Koutecky. (auth)

2819 ELECTROMETRICAL STUDIES ON URANYL COMPLEXES WITH DIISOPROPYLAMINOETHANETHIOL–HCl. Saxena, R. S.; Chaturvedi, U. S. (Malaviya Regional Engineering Coll., Jaipur, India). Monatsh. Chem.; 104: No. 5, 1208-1213 (Sep 1973). (In German).

The complexes of uranyl ion with diisopropylaminoethanethiol–hydrochloric acid were investigated by potentiometric and conductometric titration techniques in aqueous 0.1M KNO_3. It was observed that below pH 0.5, two complexes 1:1 and 1:2 are formed with considerable overlapping and the latter complex is more stable. Their log K_{stab} values were computed by alternative methods and were found to be 8.33 and 7.42 at 30°C and 8.40 and 7.72 at 40°C. The values of ΔG, ΔH and ΔS for complexation at 40°C are: 23.25 kcal/mole, 16.46 kcal/mole, and 128.0 cal/degree/mole respectively. (auth)

2820 URANATE FORMATION IN ALKALI NITRATE MELTS. Toussaint, C. J.; Avogadro, A. (Commission of the European Communities, Ispra, Italy). J. Inorg. Nucl. Chem.; 36: No. 4, 781-784(Apr 1974).

The reaction of UO_3 in molten alkal metal nitrate has been studied by x-ray diffraction. Generally if sodium nitrate is present, up to 60, 30, and 5 mol.% for sodium–lithium, sodium–potassium and sodium–cesium nitrate mixtures respectively, a solid solution is formed, which can be represented by the general formula $Na_{2-x}Me_xU_2O_7$. Maximum solubilities have been determined. X-ray powder diffraction patterns for sodium diuranate, lithium mono- and diuranate are also given. (auth)

2821 THORIUM(IV) AND URANIUM(IV) CARBAMATES. Bagnall, K. W.; Yanir, E. (Manchester Univ., Eng.). J. Inorg. Nucl. Chem.; 36: No. 4, 777-779(Apr 1974).

The insertion of CX_2(X = O,S,Se) and of COS into the metal-nitrogen bonds of thorium(IV) and uranium(IV) dialkylamides yields the corresponding carbamates. The infrared and ^{1}H-NMR spectra of these products are discussed. (auth)

2822 FORMATION OF SOME COMPOUNDS OF URANIUM AND ACCOMPANYING ELEMENTS IN CCl_3COOH MEDIUM BY PAPER ELECTROPHORESIS. Marcu, G.; Botar, A Stud. Univ. Babes-Bolyai, Ser. Chem.; 17: No. 2, 93-97(1972). (In Rumanian).

The formation of the UO_2^{2+}, Ce^{3+}, Ce^{4+}, Fe^{3+}, Co^{2+}, Ni^{2+} and Cu^{2+} complexes with CCl_3COOH by paper electrophoresis at high tension was investigated. It was found that these ions form ionic species of the type $[Me(CCl_3-COO)_2]$ and $[Me^m(CCl_3COO)_n]^{(m-n)+}$. No negative species were identified. The electrophoretic mobilities of these ionic species on Whatman Paper No. 1 were determined. It was found that in 0.2M CCl_3COOH medium uranium separates very well from Ce^{3+}, Co^{2+}, Ni^{2+} and Cu^{2+} in the range pH = 3.50–6.00. The separation of uranium from Fe^{3+} and Ce^{4+} is not good; satisfactory results were obtained in the range pH = 1.50–3.00. (auth)

2823 PROMETHIUM TECHNOLOGY. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973). 408p. (TID-26537). $22.50.

Topics covered include early developments in promethium chemistry, recovery and purification of promethium, formation and nuclear properties, dose-rate and shielding calculations for promethium metal and oxide sources, improvement of the radiation characteristics of energy-source promethium, promethium from power reactors, promethium biological considerations, practical radiation protection considerations, analytical chemistry of promethium, preparation and properties of promethium oxide, preparation and properties of promethium metal, containment of Pm_2O_3 and promethium metal at elevated temperatures, densification of promethium sesquioxide, fabrication of promethium sources, and promethium applications review. The 15 chapters were abstracted and indexed separately for NSA. (LK)

For abstracts of individual chapters see: 2626, 2627, 2824, 2825, 2847, 3462, 3463, 3479, 3709, 3809, 3880, 5061, 5218, 5233, and 5236.

2824 EARLY DEVELOPMENTS IN PROMETHIUM CHEMISTRY. Wheelwright, E. J. (Battelle Pacific Northwest Labs., Richland, WA). pp 1-18 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

The first positive identification of Element 61 was performed by J. A. Marinsky, L. E. Glendenin, and C. D. Coryell in 1945 at the Clinton Laboratory (now the Oak Ridge National Laboratory). They employed cation exchange to isolate and identify radiotracer quantities of Element 61 from the fission fragments of uranium and they named the element "prometheum". This was changed to "promethium" when their claim was recognized and the name adopted by the IUPAC Commission. The details of this discovery are reviewed. All of the known isotopes of promethium are radioactive and they decay with relatively short half-lives, seemingly precluding the existence of primordial promethium. However, the possibility of continuous production of minute amounts by spontaneous fission of uranium in uranium ores or by cosmic-ray bombardment of neodymium enticed two separate investigations. These investigations are reviewed. The relative unavailability of promethium prior to 1965 greatly restricted the amount of research work performed on promethium or its compounds. Investigations of the spectra of promethium by a number of workers and the preparation and crystallographic examination of a rather large number of promethium compounds by a group of German workers are summarized. Promethium is a typical trivalent rare earth with many properties, particularly in solution, between those of neodymium and samarium. The reader is referred to several excellent compilations of the properties of the rare-earth or lanthanide family of elements. (auth)

2825 PREPARATION AND PROPERTIES OF PROMETHIUM OXIDE. Chikalla, T. D.; Fullam, H. T.; Roberts, F. P. (Battelle Pacific Northwest Labs., Richland, WA). pp 213-258 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

To the present time, almost all of the utilization of promethium has involved the sesquioxide. For this important reason, the preparation and properties of the oxide have been extensively studied at PNL and are reviewed in considerable detail. The technology discussed includes the preparation of the oxide from the product of the purification process as well as a description of the physical and chemical properties of promethium sesquioxide. The recovery of samarium or neodymium from solution by oxalate precipitation followed by calcination to the oxide is a relatively simple process. When promethium is recovered by the same process, the complicating factors include intense radiolysis in solutions, solid compounds, and processing equipment; semi-remote or shielded processing operations; absolute containment to avoid contamination spread; the relatively high monetary value of the material; and the high-ambient temperature of the oxide powder. The presence of trace quantities of carbonaceous material or moisture in the oxide increases the rate of reaction by orders of magnitude with most containment materials at high temperature. Processing steps which minimize these impurities are discussed. There has been comparatively little evaluation of the basic physical and chemical properties of the rare-earth oxides as a group. This is undoubtedly due to the lack of significant commercial importance of most oxides in this family. Because of its lack of availability, the properties of promethium sesquioxide were, for the most part, unknown prior to the initiation of this study. With its 2.6-year half-life, ^{147}Pm represents an interesting and challenging material to investigate. The intense radioactivity makes it necessary to work with small quantities of material and simultaneously to use glove-box techniques. However, the beta decay and short half-life are ideal for studying the behavior and properties of a mixed system (i.e., Pm–Sm) where the alloying constitutent (Sm) is introduced homogeneously at the rate of 2.2% per month through the radioactive decay. (auth)

2826 VIBRATIONAL SPECTRA AND FORCE CONSTANTS OF THE ACTINIDE(IV) CHLORIDES $ThCl_4$, $PaCl_4$, UCl_4, AND $NpCl_4$. Bohres, E. W.; Krasser, W.; Schwochau, K. (Kernforshungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 36: No. 4, 809-813(Apr 1974). (In German).

The ir and Raman spectra of the isotopic, crystalline actinide(IV) chlorides $ThCl_4$, $PaCl_4$, UCl_4 and $NpCl_4$ were measured in the range of 400 to 20 cm^{-1}. The observed vibrations were assigned to the irreducible representations of the point group D_{2d} and the valence, deformation, and interaction force constants were calculated on the basis of a modified, generalized valence force field. The valence force constants increase, as the ionic radii of the actinide ions decrease. (auth)

2827 INDIRECT INFLUENCE OF SODIUM NITRATE ON THE RADIOCHEMICAL PURITY OF A Tc-SULFUR COLLOID. Dumortier, A. G. (Hospital Universitaire, St. Pierre, Brussels); Jeghers, O. M.; Decostre, P.; Fallais, C. J. Int. J. Appl. Radiat. Isotop.; 25: No. 4, 189-191(Apr 1974).

A commercially available kit has been used for the preparation of Tc-sulfur colloid by coprecipitation of ^{99m}Tc sulfide with sulfur and rhenium sulfide as a carrier in the presence of gelatin as a stabilizing agent; this dark brownish colloidal suspension

is selectively concentrated in the reticuloendothelial system (RES) with negligible surrounding background. However, in some instances the preparation exhibited a yellowish coloration and its injection to the patient not only visualized the RES but also the kidneys and a significant background. It was noticed that the yellowish suspension always occurred with the first eluates of the Mo–Tc generators, while the same kit used with subsequent elutions gave satisfactory results. This suggests that the artefact is related to a specific factor depending on the generator. The proper formation of colloids may be considered as follows: S° indirectly formed by reaction between $Na_2S_2O_3$ and HCl react respectively with TcO_4^- and ReO_4^- to form Tc_2S_7 and Re_2S_7, the latter being responsible for the dark brownish coloration. Therefore, the (VII) oxydation state of Tc and Re is necessary to obtain a good colloidal formation. From the results it is concluded that an abnormally high concentration of NO_3^-/NO_2^- may be regarded as chiefly responsible for the observed artefact. (UK)

2828 PREPARATION, CHARACTERIZATION, AND X-RAY POWDER DIFFRACTION DATA OF THE COMPOUND $UO_4 \cdot 2HN_3 \cdot 2HF$. Bachmann, H. G. (Kernforschungsanlage, Juelich, Ger.); Dokuzoguz, H. Z.; Mueller, H. M. J. Inorg. Nucl. Chem.; 36: No. 4, 795-798(Apr 1974).

A bright yellow precipitate was formed by the addition of hydrogen peroxide to a technical aqueous waste solution containing 9 M ammonium fluoride and 0.002 M uranyl ion at 50°C. The washed and dried solid, which was characterized by chemical and x-ray powder diffraction analyses, could be identified as $UO_4 \cdot 2NH_3 \cdot 2HF$, which, it is believed, has not been reported before. The compound is isostructural with $UO_4 \cdot 4H_2O$. X-ray data are presented. (auth)

Radioactive Waste Treatment

Refer also to abstracts 2693 and 4064.

2829 (ANL-8087) CHEMICAL ENGINEERING DIVISION WASTE MANAGEMENT PROGRAMS. Quarterly Report, October–December 1973. Steindler, M. J.; Levitz, N. M.; Trevorrow, L. E.; Gerding, T. J.; Kullen, B. J.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 44p. Dep. NTIS $4.00.

Metal-compaction methods have been reviewed and information on the irradiation-induced property changes of Zircaloy surveyed as part of a study on the handling of fuel cladding hulls. Information originating from AEC-site visits and from a review of the open literature concerning decontamination of plutonium-contaminated materials is presented. The technical and economic feasibility of adapting reverse osmosis to the concentration of tritium from tritiated fuel reprocessing wastes was briefly evaluated. Technical feasibility was assumed from literature reports of a difference of about 3% in the self-diffusion coefficients of THO and H_2O, and possibly greater differences in transport rates in solution-diffusion membranes. The costs of such a process were calculated from (1) estimates for the single-stage separation factor, (2) the heads flow rate for assumed concentrations and volumes of feed, product, and waste in an ideal cascade of membranes, and (3) published costs for reverse osmosis equipment. The result ranged from 10^{-4} to 1 mill/kWh of nuclear power, depending on the assumed single-stage separation factor and whether tritium-depleted water was recycled to the reprocessing plant. (auth)

2830 (ARH-SA-191) EFFLUENT CONTROL FACILITIES 242-S EVAPORATOR-CRYSTALLIZER. Muller, M. E.; Roal, R. C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 26 Mar 1974. Contract AT(45-1)-2130. 18p. (CONF-740406-10). Dep. NTIS $4.00.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Approximately 100 million gallons of radioactive waste solutions generated at the Hanford site since 1944 from irradiated fuel reprocessing have been stored as basic aqueous solutions in underground tanks. As part of the Hanford Waste Management Program, these wastes are currently being converted to salt cake for interim storage in the underground tanks. A new facility which employs a vacuum evaporator-crystallizer process for solidification of the wastes has recently been placed in operation. Effluents from the facility include steam and process condensates, condenser cooling water, and gaseous wastes. Methods and equipment used in the facility to remove radioactive contamination from the effluents prior to discharge to the environment are described. Instrumentation utilized to detect abnormal activity in the effluent streams and to initiate corrective action is also covered. (auth)

2831 (BNWL-SA-4844) HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT RESEARCH AND DEVELOPMENT PROGRAM AT BATTELLE PACIFIC NORTHWEST LABORATORIES. Mendel, J. E.; McElroy, J. L.; Platt, A. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 30p. (CONF-740428-2). Dep. NTIS $4.50.

From 167th national meeting of the American Chemical Society; Los Angeles, California, USA (1 Apr 1974).

The waste management research and development program at BPNL may be summarized as consisting of, first, mainline effort to develop near-term technology for the fixation of commercially-produced high-level wastes in silicate glass or ceramic forms. Fully radioactive engineering-scale demonstrations of the processes are scheduled to begin in 1975. Second, a comprehensive examination of potential advanced waste forms is being carried out which may offer further increments of safety or economy over the long-term. (auth)

2832 (CONF-740434-2) METHODS FOR REMOVAL OF ACTINIDES FROM HIGH-LEVEL WASTES. Bond, W. D. (Oak Ridge National Lab., Tenn. (USA)). [nd] 22p. Dep. NTIS $4.25.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

It appears that it will be feasible to reduce the long-term hazards of waste by more complete removal of actinides. However, many challenging problems must be solved before satisfactory processes can be developed and in turn demonstrated on a "hot-pilot" plant scale. It appears the necessary U and Np removals can probably be accomplished by modification and addition to the current Purex process. A number of specific chemical problems have been identified which must be solved before satisfactory chemical process flowsheets can be developed for the very high degrees of removal required for Pu, Am, and Cm. (auth)

2833 (DP-MS-73-58) SOLID FORMS FOR SAVANNAH RIVER PLANT RADIOACTIVE WASTE. Bradley, R. F.; Hale, W. H.; Wallace, R. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 62p. (CONF-740428-4). Dep. NTIS $6.25.

From 167th national meeting of the American Chemical Society; Los Angeles, California, USA (1 Apr 1974).

Methods are being developed to immobilize Savannah River Plant (SRP) wastes in high-integrity, solid forms. The waste forms will be suitable for storage in a retrievable surface storage facility for about one hundred years and for eventual shipment to an off-site repository. Alkaline wastes produced in the SRP separations plants are currently stored in mild steel tanks. These wastes consist of a water-soluble fraction (supernate or salt cake) containing most of the ^{137}Cs and an insoluble sludge containing most of the ^{90}Sr. These two radionuclides are the major biological hazards and heat producers. The power density of 10-year-old SRP waste is about 0.008 watt/liter. A conceptual process is being studied. In the first part of the process, the sludge is separated from the supernate, and the ^{137}Cs is removed from the clarified supernate. The decontaminated supernate, which possesses little heat or hazard, will be solidified and stored in bulk. In the second part of the conceptual process, ^{137}Cs (removed from the supernate) and the sludge are immobilized in solid waste forms of high integrity and low volume for retrievable storage. The R&D program includes studies of removal of sludge from (and final decontamination of) waste tanks, sludge processing prior to solidification, ^{137}Cs removal from supernate, and immobilization of ^{137}Cs and sludge in various solid forms. Low temperature solidification processes, especially incorporation in cement, are favored at present, but others are being considered. Economic analyses to reduce costs, and fault-free analyses to minimize waste management risks are being conducted simultaneously. (auth)

2834 (IAEA-R-428-F) STUDY OF THE SORPTIVE CHARACTERISTICS OF LOCAL TUFF FOR WASTE TREATMENT AND DISPOSAL. Final Report, 1 September 1966–15 December 1972. Ibe, L. D.; Bernardo, B.; Cabalfin, E. A.; Marasigan, C. J. (International Atomic Energy Agency, Vienna (Austria)). Oct 1972. 9p. INIS.

A study to evaluate the sorptive characteristic of volcanic tuff found within the site of the Philippine Atomic Research Center was undertaken. The local natural sorbent was primarily montmorillonite clays, pumice, andesitic, and basaltic tuffs. The project was divided into two stages: (a) laboratory-scale studies and (b) pilot-plant scale studies. In the corollary study, storage properties of the tuff immobilized into Portland cement were also determined. It was concluded that local tuff can be used for the treatment of cobalt and strontium radioactive waste. (INIS)

2835 (INIS-mf-936, pp 8-21) DECONTAMINATION OF LOW-LEVEL RADIOACTIVE WATERS. Berak, L.; Uher, E. May 1973.

The development of techniques for low-level radioactive waste decontamination elaborated by NRI Rez is reviewed. Attention

was focused on research into inorganic selective sorbents, such as aluminosilicates, $BaSO_4$-$CaSO_4$, and phosphate sorbents, and organic selective sorbents, such as ion exchangers whose functional groups are derivatives of phosphinic, phosphonic, and phosphoric acids, phosphorylated sawdust and coal, and chelating ion exchangers based on polyaminoalkylcarbonic acids. An analysis of the quantitative background of ion exchange was made to assess the maximum possible efficiency of ion exchanger systems and their limitations. Also, colloidal states were studied of the following radionuclides at concentrations of between 10^{-6} and 10^{-12} M: ^{106}Ru and ^{106}RuON, ^{144}Ce(III), ^{147}Pm(III), ^{155}Eu(III), ^{85}Sr, ^{59}Fe(III), ^{52}Mn, and of Ag and Y(III) in the presence of Fe(III) and Sr(II). Special sorption contactors were developed applicable in sorption on powders that replace the conventional sorption columns and make possible a large-scale application of activated powdered $BaSO_4$. (INIS)

2836 (NP-19981) REMOVAL OF STRONTIUM AND CESIUM FROM RADIOACTIVE WASTE WATERS BY COAGULATION-FLOCCULATION OF FERRIC HYDROXIDE. Bull, P. S. (New South Wales Univ., Kensington (Australia)). 1974. 45p. Dep. NTIS (US Sales Only) $5.25.

Thesis.

Adsorption of strontium and cesium on ferric hydroxide flocs was investigated. Data on the effects of the major chemical and physical variables on the extent of adsorption are presented. The adsorption of strontium is increased by an increase in pH, an increase in iron concentration, and by the presence of phosphate anions. The lower the initial strontium concentration the higher is the percentage of strontium adsorbed. The process of coagulation–flocculation with ferric hydroxide should be a practical means of removing strontium radioisotopes from radioactive waste solutions. The adsorption of cesium is poor under all conditions and the process is not a practical means of removing cesium from radioactive wastes. Evidence is presented which indicates that the mechanism of the adsorption is by an ion-exchange reaction on the surface of the ferric hydroxide floc particles. (auth)

2837 TREATMENT AND STORAGE OF FISSION-PRODUCT WASTES FROM NUCLEAR POWER STATIONS. Went, J. J. Ingenieur (Utrecht); 85: No. 28-29, 600-603(12 Jul 1973). (In Dutch).

Existing techniques for treatment and storage of radioactive wastes are summarized. The need for improving and extending these techniques is emphasized, particularly in the area of long-lived radioisotopes, if the planned growth of nuclear power over the next decades is not to be seriously impeded by environmental and security considerations. (NL)

2838 FISSION PRODUCT VITRIFICATION PROCESS AND THE FRENCH PIVER PLANT. Com. Naz. Energ. Nucl., Notiz.; 20: No. 1, 36-43(Jan 1974). (In Italian).

Some general aspects of the fission product vitrification process are discussed. Then the chemical aspects of the process, the in-vessel batch process, and the continuous process are considered. The PIVER pilot plant installed at France's Marcoule Center to process the fission product solutions from the Marcoule Pu production plant (UP1) and the Pilot Plant for the processing of irradiated fuels (APTCI) are described. (auth)

2839 PRELIMINARY RESULTS FROM THE INVESTIGATION OF PULSATING SORPTION COLUMNS FOR THE DECONTAMINATION OF LIQUID WASTES. Rauzen, F. V.; Zakharov, E. I.; Ryabchikov, B. E.; Konorchenko, V. D.; Odintsova, E. G. At. Energ. (USSR); 36: No. 1, 27-31(Jan 1974). (In Russian).

Preliminary results from testing pulsating sorption packed columns in the process of decontaminating radioactive wastes at the Moscow decontamination station are examined. The construction of the continuously operating pulsating columns and their arrangement are described. It is shown that using such columns one can obtain the same decontamination coefficients as with sorption filters. The column efficiency is 4–5 times greater, and a charge of tar that much less than in filters. In trying various regimes, the authors found that the least volume of apparatus is obtained when using columns in a regime with a large retention of tar in the apparatus. (4 figures, 2 tables, 10 references.) (auth)

2840 SOLIDIFICATION OF FISSION PRODUCT SOLUTIONS. Bonniaud, B. (Centre de Marcoule, Bagnols-sur-Ceze, France). Bull. Inform. Sci. Tech. (Paris); No. 188, 27-37(Jan 1974). (In French).

Fission product solutions are a very important source of waste. The solution adopted in many countries for the treatment of such products is their transformation into vitreous solids. The current state of CEA research in this field is described, particular emphasis being given to hot cell experiments. Currently developing techniques that are expected to be industrialized in the next few years are also emphasized. (FR)

Radioisotope Production

Refer also to abstract 2801.

2841 (SGAE-2223) PREPARATION OF READY-TO-USE ^{99m}Tc AND RADIOPHARMACEUTICALS LABELED WITH IT. Angelberger, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Chemie). Jan 1974. 6p. (In German). (CONF-740120-1). Dep. NTIS (U. S. Sales Only) $4.00.

From eleventh international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974).

A production method for ^{99m}Tc was developed. It permits the delivery of ready-to-use pertechnetate solutions and Tc-labeled radiopharmaceuticals to clinics in the area of Vienna. The method is based on the liquid-liquid extraction of TcO_4^- with very pure methyl ethyl ketone from an alkaline solution of irradiated MoO_3. The radiopharmaceuticals were produced by the reduction of TcO_4^- with Sn^{2+} solutions and its reaction with a complexing agent present in the solution. The preparation is simple and rapid without exclusion of air and yields sterile drugs with low Sn concentration and high stability of the complex formed. Among the drugs prepared are ^{99m}Tc-labeled DTPA, human serum albumin, HSA microspheres, sodium phytate, and bleomycin. (JSR)

2842 PHOTONUCLEAR REACTIONS IN MEDICINE. McNeill, K. G. (Univ. of Toronto). Phys. Today; 27: No. 4, 75-77; 79; 81; 83(Apr 1974).

Photonuclear reactions can be used to produce useful radioisotopes of several medically important elements, such as short lived ^{11}C, ^{13}N, ^{15}O, and ^{18}F. When a photoneutron reaction takes place, the product nucleus usually recoils out of the molecule in which it was originally situated—because of this, hot-atom chemistry can be used to produce high specific activities. If charged particles are emitted in the reaction, the activity can be separated by means of relatively routine procedures, since the daughter nucleus is a different element from the mother. Photonuclear reactions have unique advantages in activation analysis of biological samples. Photon activation analysis has been used for detection of lead and analysis of organic material, including analysis in vivo. The production of radioisotopes by photodisintegration processes or the use of these processes in analysis usually requires expensive electron accelerators; however, some elements can be analyzed with gamma rays from nuclides such as ^{60}Co, this ability obviating the need of an electron accelerator. A table of forty-nine elements analyzable by photo-induced reactions is given. (3 figures, 3 tables) (RWR)

2843 METHOD OF PRECIPITATING AMERICIUM OXIDE FROM A MIXTURE OF AMERICIUM AND PLUTONIUM METALS IN A FUSED SALT BATH CONTAINING PuO_2. Strickland, W. R.; Auge, R. G.; Brown, J. C. (to United States Atomic Energy Commission). US Patent 3,804,939. 16 Apr 1974. Filed date 21 Jun 1972. 4p.

A method of recovering americium from plutonium metal source material containing americium involves contacting molten plutonium metal source material with an about equal weight of molten equimolar salt mixture of NaCl and KCl containing no more than ~25 wt % plutonium oxide as a reductant to convert the americium to americium oxide. The salt mixture containing the americium oxide is separated from the plutonium; the americium is then separated from the salt mixture. (LK)

2844 DEVICE FOR PREPARING ELEMENTAL CARBON ENRICHED IN CARBON-13. Liner, J. C. US Patent 3,796,545. 12 Mar 1974. Filed date 23 Feb 1972. 4p.

Apparatus is described for use in preparing elemental carbon comprising a tubular member having an apertured wall portion separating the member into first and second chambers with means disposed on said apertured wall portion to facilitate passage of a fluid released from first chamber into second chamber and impede return of the fluid to the first chamber. (Official Gazette)

2845 ^{113m}In-MACROAGGREGATE STABILIZED WITH PVP FOR LUNG SCANNING. Rybakow, Z. (Inst. of Nuclear Research, Warsaw); Lachnik, E.; Kulesza, A.; Sakowicz, A., Licinska, I. Nucl.-Med.; 12: No. 4, 341-345(Jan 1974).

A simple and easily reproducible kit technique for the preparation of a $^{(113m)}$In–$Fe(OH)_3$ macroaggregate, based on the use of

PVP as a stabilizer, has been described. Its advantage seems to be the elimination of problems associated with the use of gelatin. Using this kit and the described procedure, a sterile and pyrogen-free lung scanning agent may be prepared in 15 min. The size of the particles and their organ distribution in mice was studied and the preparation was found suitable for clinical use. Instant kits of ^{113m}In-macroaggregate described in this paper have been prepared for over a year and have been used for routine lung scanning studies. (GE)

2846 GAS–LIQUID PURIFICATION COLUMNS FOR RADIOACTIVE GASES. Nakhutin, I. E.; Rubezhnyi, Yu. G. At. Energ. (USSR); 36: No. 3, 195-197(Mar 1974). (In Russian).

The removal of radioactive gases is often a complex problem that is not solved by simple methods. Particularly difficult is the removal of radioactive noble gases. Mass-exchange with liquid air may be used to remove such gases. In the case of short-lived radioactive isotopes the process is complicated by radioactive decay. Under such conditions gas-liquid columns are very effective. As an example, the use of columns of the aforementioned type in the removal of ^{41}Ar from air is considered. (auth)

2847 PROMETHIUM FROM POWER REACTORS. McKee, R. W. (Battelle Pacific Northwest Labs., Richland, WA). pp 151-160 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Projected availability of ^{147}Pm from nuclear power reactor operations are developed through the year 2000. The projections include a Base Case or "best estimate" as well as Low and High Case projections. The effect of aging for either 2 or 3 years after reactor discharge to allow for decay of the 43-day ^{149m}Pm is included in the projections. Because the time lag between the placing of an order for a nuclear reactor and the first recovery of promethium is approximately 10 years, the ^{147}Pm availability through 1982 can be defined with considerable confidence. Beyond 1982 the uncertainties in the projections are much greater. With 3-year aging, ^{147}Pm availability increases from 1 kg/year in 1970 to a range of 120 to 140 kg/year in 1980, and 1500 to 2600 kg/year in the year 2000. With 2-year aging, ^{147}Pm availability increases from 2 kg/year in 1970 to a range of 205 to 230 kg/year in 1980 and 2000 to 3600 kg/year in the year 2000. The basis and details of these projections are discussed under the following headings: introduction; nuclear power projections; basis for ^{147}Pm availability projections; and ^{147}Pm availability projections. (auth)

2848 RADIOACTIVE GENERATOR WITH PERMEABLE CLOSURE. Hulit, H. J.; Czaplinski, T. V. (to E. R. Squibb and Sons, Inc.). US Patent 3,801,818. 2 Apr 1974. Filed date 24 Oct 1972. 4p.

A radioactive generator which has silicone or neoprene closures to vent the gases released during the generation of radioactive eluate is reported. The generator is composed of a hollow, generally cylindrical body in which a column of radioactive material is contained, and the ends of which are closed by silicone or neoprene stoppers fabricated from material such as methylvinylpolysiloxane or polychloroprene. The generator can be subjected to sterilizing procedures such as autoclaving and retain its sterile condition, while at the same time gases generated internally may be vented through the closures. (Official Gazette)

Reactor Fuel Reprocessing

2849 (CEA-BIB-208) NON DESTRUCTIVE ASSAY OF FISSILE MATERIALS. Le Levier, M. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Documentation). Mar 1974. 36p. (In French and English). Dep. NTIS (US Sales Only) $5.00.

This bibliography deals with 86 references selected from volumes 25 and 26 of Nuclear Science Abstracts (1972–1973). Journal items, reports, conference papers, and patents are included. An author index and a subject index as well as abstracts are included. (JGB)

2850 (CONF-740501-, pp 257-267) PROGRESS IN THE THORIUM–URANIUM 233 REPROCESSING-REFABRICATION TECHNOLOGY. Brooks, L. H. (General Atomic Co., San Diego, CA); Lotts, A. L.; Wymer, R. G. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Salient features of HTGR fuel recycle technology as it exists today are presented, and some possible improvements that are being investigated are mentioned. HTGR fuel, HTGR spent fuel shipping system, spent fuel reprocessing, fuel refabrication, and radwaste are considered. (LK)

2851 (CONF-740501-, pp 268-287) PROGRESS IN Th–^{233}U RECYCLE TECHNOLOGY. Merz, E. R.; Kaiser, G.; Zimmer, E. (Kernforschungsanlage, Juelich, Ger.). 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The JUPITER reprocessing facility is described. Areas covered are: combustion head-end; dissolution and feed-adjustment; and solvent extraction. Refabrication of nuclear fuel particles and the time schedule are also covered. (LK)

2852 (CONF-740501-4) PROGRESS IN THE THORIUM–URANIUM 233 REPROCESSING–REFABRICATION TECHNOLOGY. Brooks, L. H.; Wymer, R. G.; Lotts, A. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 12p. Dep. NTIS $4.00.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

Salient features of HTGR fuel recycle technology as it exists today are presented, and some possible improvements that are being investigated are mentioned. HTGR fuel, HTGR spent fuel shipping system, spent fuel reprocessing, fuel reprocessing, fuel refabrication, and radwaste are considered. (LK)

2853 (DOCKET-50201-149) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Supplement 3. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 26 Apr 1974. 196p. Dep. NTIS $13.00.

2854 (DOCKET-50201-150) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Supplement 4. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 26 Apr 1974. 340p. Dep. NTIS $20.00.

2855 (ICP-1043) BREAKING SILICON CARBIDE COATED UNIRRADIATED FT. ST. VRAIN FUEL PARTICLES BY JET GRINDING. Palmer, W. B. (Allied Chemical Corp., Idaho Falls, Idaho (USA)). Apr 1974. Contract AT(10-1)-1375. 20p. Dep. NTIS $4.00.

The feasibility of using jet grinders to break nonirradiated silicon carbide coatings from Ft. St. Vrain fuel particles was studied experimentally. The results show that jet grinding is an effective means of separating the silicon carbide from the uranium- and thorium-containing fuel kernel. (auth)

2856 (ICP-1051) DEVELOPMENT OF A GAS CLASSIFICATION METHOD FOR SEPARATING FT. ST. VRAIN TRISO–TRISO FUEL PARTICLES. Valentine, M. K. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). Apr 1974. Contract AT(10-1)-1375. 29p. Dep. NTIS $4.00.

A method for separating Ft. St. Vrain TRISO–TRISO fuel particles in a vertical gas classifier was defined. Step-by-step development of the classifier from bench-scale to a pilot-plant system is discussed. Separation of the fissile and fertile fuel particles to 99% pure fissile particles and 96% pure fertile particles was demonstrated in the pilot plant. (auth)

2857 (JUL-1043-RW) INVESTIGATION OF PHENOLIC-FORMALDEHYDE PYROLYSIS. A Contribution for Optimizing the Matrix Materials of Fuel Elements for High Temperature Reactors. Boecker, D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Jan 1974. 107p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The pyrolysis of phenolic-formaldehyde resins used as binder material for the graphitic components was studied. By means of thermal gravimetry, mass spectrometry, ir spectrometric measurements and gas generation analysis six selected resol and novolac resins were investigated. Effects of the nature of the resin, the mole ratio formaldehyde/phenol in the raw materials, and the heat treatments (isothermal or non-isothermal) on the pyrolysis and on the yield of coke are described. A quantitative illustration of the progress of pyrolysis and the carburization mechanism are discussed. (auth)

2858 METHOD FOR SUPPRESSING FORMATION OF ORGANIC IODIDES BY REACTION OF CARRIER-FREE IODINE-131 IN HNO_3 SOLUTIONS. Numakura, K.; Saeki, M.; Tachikawa, E. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 12, 762-764(Dec 1973).

The ^{131}I–HNO_3 system was studied in order to determine conditions that would minimize the formation of organic iodides. Gas chromatography and scintillation counting were used for separation and identification of the organic iodides. Yields tended to decrease with a decrease in temperature from 100° ± 5°C to 56° ± 5°C. Comparative studies were made using H_2SO_4, HCl, or $HClO_4$,

instead of HNO_3. The addition of an ^{127}I carrier (10^{-6} mole to the 10.9N HNO_3 solution) reduced the organic yield to $1/200$, and 97% of the ^{131}I was transferred to the alkaline solution. Results indicate addition of the ^{127}I carrier to be the most promising means of controlling the organic iodine yields. (JGB)

2859 SEPARATION TECHNIQUES FOR USEFUL RADIOISOTOPES FROM THE WASTE OF NUCLEAR FUEL REPROCESSING. Amano, H. (Japan Atomic Energy Research Inst., Ibaraki). Radioisotopes (Tokyo); 21: No. 12, 724-732(Dec 1972). (In Japanese).

While usual method is by irradiating target materials in a nuclear reactor, the reactor itself is a tremendous mass of radioisotopes. The chance to take out these useful species in nuclear fuel is at the time of its spent-fuel reprocessing. To provide some information to help the efforts in Japan in the future, current techniques in the world are reviewed. The perspective of related matters is first explained. The recovery of the useful radioisotopes from the wastes in fuel reprocessing can be divided into two classes (i.e., from gaseous and liquid wastes). In the former are ^{85}Kr, ^{3}H, etc.; the recovery of ^{85}Kr is carried out in three steps, pretreatment, separation, and purification. In the separation of the radioisotopes from the liquid waste, there are ^{137}Cs by inorganic ion exchange, Sr and rare-earth elements by $PbSO_4$ coprecipitation; Sr by solvent extraction; Sr, rare-earth elements, etc. continuously by solvent extraction; and fission products continuously by ion exchange. (JA)

2860 METHOD FOR REMOVING IODINE FROM NITRIC ACID. Cathers, G. I.; Shipman, C. J. (to United States Atomic Energy Commission). US Patent 3,803,295. Apr 1974. Filed date 21 Dec 1972. 4p.

A method for removing small amounts of radioactive iodine from nitric acid solution by isotopically diluting the iodine, sparging the solution with ozone, and distilling the iodine from solution is described. (Official Gazette)

2861 FACILITIES FOR STUDYING FUEL REPROCESSING USING THE FLUORIDE VOLATILITY PROCESS. Bourgeois, M. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 188, 7-16(Jan 1974). (In French).

Various techniques were developed for the reprocessing fuels by the fluoride volatility process: highly exothermic gas–solid reactions, gas-phase reactions, gas–solid separation by filtering, separation by condensation, sublimation, and sorption desorption. Three installations were used for the studies: CLOVIS (non-irradiated mixed UO_2–PuO_2 oxides); ATTILA and CANDIDE for irradiated fuels (U.Al, U.Zr alloys, fast neutron reactor fuels). (FR)

2862 PREPARATION OF SOLUTIONS OF MIXED URANIUM AND PLUTONIUM NITRATES. Lane, E. S.; Jackson, N. (to United Kingdom Atomic Energy Authority). US Patent 3,804,772. 16 Apr 1974. Priority date 18 Jan 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

An improved method for the preparation of solutions of mixed uranium and plutonium nitrates is reported. A mixed uranium and plutonium solution in which the nitrate concentration is slightly greater than, equal to, or less than that required for U(VI) and Pu(IV) valencies is prepared by mixing a plutonium(IV) nitrate solution containing nitric acid with a diuranate, uranium trioxide, or a solution of uranium trioxide in uranyl nitrate. It is thus possible to prepare mixed solutions in which the mole ratio of plutonium to uranium and the mole ratio of nitrate to total metal can be varied according to the nitrate concentration desirable for subsequent operations. (Official Gazette)

2863 PROCESS FOR THE REDUCTION OF URANYL SALTS. Robins, R. G.; Edenborough, B. W. (to Unisearch Ltd.). US Patent 3,801,701. 2 Apr 1974. Priority date 20 May 1969, Australia. 6p.

An improved process is reported for the production of uranium dioxide. It involves the reduction of an acid solution of a uranyl salt, preferably the sulfate, nitrate, chloride, acetate, or perchlorate, or a mixture of any of these salts, with a carbohydrate, such as sucrose, D-glucose, D-fructose, starch or a saccharide, at a temperature of between 60°C and 300°C until the uranyl solution is reduced to uranium dioxide. (Official Gazette)

CONTROLLED THERMONUCLEAR RESEARCH

2864 (RISO-300) PHYSICS DEPARTMENT ANNUAL PROGRESS REPORT, 1 JANUARY – 31 DECEMBER 1973. Moeller, H. B.; Lebech, B. (eds.). (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1973. 81p. Dep. NTIS (US Sales Only) $7.25.

Research on solid-state and plasma physics, nuclear spectroscopy, and meteorology is summarized. (JFP)

2865 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 3, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 41p.

Confinement and Heating

Refer also to abstracts 2941, 2959, and 2972.

2866 (COO-2288-5) ABSORPTION OF ELECTROMAGNETIC WAVES NEAR THE CRITICAL DENSITY. Quarterly Progress Report, December 1, 1973 – March 1, 1974. Rehm, R. G.; Daiber, J. W.; Thompson, H. M. (Calspan Corp., Buffalo, N. Y. (USA)). 1974. Contract AT(11-1)-2288. 2p. Dep. NTIS $4.00.

The program is an experimental study of the interaction of high-intensity ruby laser radiation with hydrogen gas in a free-jet. In these experiments both laser intensity and the plasma frequency can be varied. By monitoring several parameters, including incident and reflected power, x-ray emission and the kinematics of plasma growth, the existence of an anomalous threshold for coupling radiation into plasma energy should be determinable. (auth)

2867 (IPPCZ-178) MICROWAVE HEATING OF ELECTRONS OF A DENSE PLASMA COLUMN AT FREQUENCIES HIGHER THAN ELECTRON CYCLOTRON FREQUENCY. II. Excited Electron Cyclotron Harmonic Waves and Their Resonant Wave–Wave Interaction. Datlov, J.; Klima, R.; Kryska, L.; Budnikov, V. N.; Shcherbinin, O. N. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jan 1973. 48p. INIS.

In an overdense collisionless plasma column inserted through the narrow sides of a rectangular waveguide, the excited electron cyclotron harmonic waves (CH waves) were studied using two movable probes and a phase interferometer in the range of parameters of $2 > \omega/\omega_{ce} > 1$; $0.5 < (\omega_{pe}/\omega)^2 < 15$. Two kinds of CH waves were found in the dipole mode, namely: (a) stable backward CH waves with phase velocity in the direction from the axis to the periphery; and (b) unstable backward CH waves with phase velocity in the opposite direction. From the correlation measurements and amplitude distribution of the CH waves at the frequency applied and its second harmonic, an efficient nonlinear resonant interaction of CH waves was found to take place in the range of $2 > \omega/\omega_{ce} > 1.5$. The position of the loci of resonant interaction inside the plasma column was found both experimentally and by a new simple graphical procedure for the resonant conditions in the form of $\omega_2 = 2\omega_1$; $k_2 = 2\,|k_1|$. In the absence of this condition, no effective generation of the second harmonic frequency was found. The resonant interaction of CH waves at $\omega/\omega_{ce} = 1.85$ was found to be the reason for the self-trapping of CH waves between the zones of resonant interaction in the radial direction and for an anomalous heating rate of electrons. (auth)

2868 (NP-19986) HEATING OF THE JET PLASMA BY CURRENT-DRIVEN TURBULENCE. Rijnhuizen Report 73-82. Piekaar, H. W.; de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Dec 1973. 10p. Dep. NTIS (US Sales Only) $4.00.

Two specific proposals are presented for the turbulent heating of the Joint European Tokamak. One method does not rely on the quasi-stationary poloidal Tokamak current of 3 MA, the other method economizes on the required capacitor energy by using the poloidal current as a basis for the temporarily high heating current. The methods are described in some detail. (MOW)

2869 (TRITA-EPP-73-19) PLASMA CONFINEMENT IN PRESENCE OF MAGNETICALLY SHIELDED SUPPORTS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Dec 1973. 59p. Dep. NTIS (US Sales Only) $6.00.

During recent investigations on plasma confinement by internal ring systems with magnetically shielded supports some authors have arrived at contradictory conclusions. This paper reconsiders support shielding in terms of the problems of plasma cut-off at the support surfaces, the plasma equilibrium in presence of the support field, non-adiabatic effects on transit and trapped particles, and magnetic field misalignment in the weak-field regions: (1) the support ratio $R_s = d_t/2d_1g_s$ and the curvature ratio $R_B = r_B/2d_1g_s$ are crucial parameters in respect to the confinement. Here $2d_1$ and d_t are the separation distance and the length of the supports, r_B is the local radius of curvature of the main field in the support region, and g_s is a monotonically increasing function of the support magnetization current reaching $g_s = 1$ in the force-free case. As a necessary condition for an effective confinement R_s and R_B have to be chosen substantially larger than unity. (2) Taking all effects and parameter values into proper account, there are found to be no contradictions between theory and experiments so far. In particular, for some earlier experiments with large observed loss rates such as in the Wisconsin octupole, theory predicts a poor confinement, whereas the decreased loss levels observed in presence of support shielding in the Stockholm F IV device and in the Los Alamos quadrupole also become consistent with theory. (auth)

2870 (TRITA-EPP-74-1) PLASMA HEATING IN INTERNAL RING SYSTEMS WITH SHIELDED SUPPORTS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 10 Jan 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

A short general discussion is given on the heating methods applied to quasi-steady impermeable plasmas confined in the purely poloidal field of internal ring systems with magnetically shielded supports. Two mechanisms should fulfill the requirements of efficient heating at moderately high plasma temperatures. The first is based on oscillating modes, ranging from the lowest eigenfrequencies of the plasma and upwards. The second is due to low-frequency Ohmic heating by induced poloidal currents flowing along the magnetic field lines. (auth)

2871 ELECTROMAGNETIC INSTABILITIES, FILAMENTATION, AND FOCUSING OF RELATIVISTIC ELECTRON BEAMS. Lee, R.; Lampe, M. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Rev. Lett. 31: No. 23, 1390-1393 (3 Dec 1973)

We report nonlinear studies of the Weibel instability of a relativistic electron beam in a plasma. If $n_b < n_p$, the beam splits into self-pinched filaments at density n_p. These filaments then recombine into a single dense beam, from which the return current is expelled. The ratio of final magnetic to final streaming energy is $O(v/\gamma)$, and significant plasma heating occurs. (auth)

2872 HIGH-BETA PLASMAS CONFINED IN POLOIDAL MAGNETIC FIELDS. Lehnert, B.; Hellsten, T.; Raggi, R. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 9: No. 2, 53-60(Jan 1974).

Experiments on rotating plasmas provide methods for studying part of the important problems of plasma equilibrium and stability at high beta values. This report describes investigations on high-density plasmas being performed by means of probe and Rogowski coil recordings: (1) Appreciable forces can be generated in the plasma, corresponding to equivalent beta values as high as about 20%. The magnetic field lines are in some cases "pushed out" radially by a considerable fraction of the distance from the axis of symmetry. (2) The observed plasma behavior agrees roughly with that predicted by a simple classical model. (3) The plasma is at least macroscopically stable in respect to flute and ballooning modes, and has an outer boundary being sharply defined by the conditions imposed by a limiter and a surrounding neutral gas blanket. (auth)

2873 APPLICATION OF QUASILINEAR THEORY TO TURBULENT HEATING EXPERIMENTS. Mondelli, A.; Ott, E. (Maxwell Labs., Inc., San Diego, CA). Plasma Phys.; 16: No. 5, 413-421(May 1974).

Quasilinear theory was applied to the Cornell turbulent heating experiments with the inclusion of the actual external circuitry of the experiments in the model. The resulting set of coupled, first-order, ordinary differential equations were integrated numerically by the Runge-Kutta-Gill technique. A one-dimensional model with Maxwellian electrons and ions, assuming a current-driven ion-acoustic instability as the heating mechanism was employed. The observed high-energy ion component was therefore excluded from the analysis. The computed current and voltage vs time had several significant points of agreement with those in the experiments, including the "spikey" structure observed in the voltage traces and the premature quenching of the instability noted in the ex-

periments. The computed final ion temperature was in reasonable agreement with the experimentally observed bulk ion temperature (excluding the high-energy ion tail). The total electron plus ion final temperature was consistent with the diamagnetic signals observed in the experiments. The premature turn-off of the instability appeared in the calculation to be due to ions heating more efficiently than electrons, resulting in a decrease of T_e/T_i, which stabilized the instability. As the electron drift velocity rose, the instability turned on and off several times, until T_e/T_i had decreased to the point where the drift velocity could no longer cross the threshold for instability. The observed voltage spikes were due to the successive recurrences of the instability. The duration of the computed voltage spikes was in good agreement with the experimentally observed voltage traces. (auth)

2874 DEVICE FOR HEATING AND STABILIZING A TOROIDAL PLASMA. Minardi, E.; Ornstein, L. T. M.; Rem, J.; Schram, D. C. Luxembourg Patent 63,600. 23 Jul 1971. vp. (In German).

In a Tokamak plasma device, a toroidal electric field is produced at the final stage of the ohmic heating, the frequency of which is equal to the bounce frequency of the particles trapped in the small banana orbits. As a consequence of the resonant interaction, the trapped particles increase their energy and the size of their banana orbits. On the one hand the untrapped particles are brought to a higher energy by collisions with the trapped particles. On the other hand, the trapped particles are shifted towards regions more favorable for stability. In this way heating and stabilization of the plasma can be reached. (auth)

2875 NUCLEAR FUSION PLASMA RESEARCH BY LASER. Yamanaka, C. (Osaka Univ., Suita, Japan); Yamanaka, T.; Yoshida, K.; Waki, M.; Kang, H. B. Denki Gakkai Ronbunshi, A; 92: No. 12, 561-567(Dec 1972). (In Japanese).

A study of the heating mechanism by lasers was performed to investigate the abnormality of electron temperature, ion temperature, ion velocity, and photoreflectivity of plasma. The experimental apparatus consisted of a high-power laser, a target, and a diagnosis system. The high-power glass laser was composed of an oscillator and a five-stage amplifier. The power of the laser was 40 J of energy, 2 ns of pulse width, and 20 GW of power. A solid deuterium target was inserted into a high vacuum of 10^{-7} torr. (JA)

2876 INJECTION OF RELATIVISTIC ELECTRON BEAMS WITH ARBITRARY RADIAL PROFILES INTO WARM COLLISIONAL PLASMA. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 16: No. 4, 317-332(Apr 1974).

The results of previous authors for the injection of relativistic electron beams into unmagnetized collisional plasmas were generalized by allowing for arbitrary radial beam profiles and finite electron temperature. For $\nu t' \ll 1$ (ν = collision frequency of plasma electrons, t' = time after passing of the beam front) the magnetic field B depended strongly on the beam profile, smooth or sharp in units of the plasma skin depth c/ω_p. For $\nu t' \cong \nu t_D = (R\omega_p/c)^2 \gg 1$ (R = beam radius) the return current had diffused out of the beam and magnetic shielding was lost. For beam currents well above the Alfven current and with $n'/n = 10^{-1}$ or 10^{-3} (n' = beam density, n_e = plasma density) critical times for which the beam was seriously affected or destroyed by pinching were calculated numerically. A parabolic and a step function profile were used for comparison and the critical times were found to be only weakly dependent on the profile. The return current heating time, which determines the maximum free path of the beam was also calculated. Finite plasma temperature did not affect the magnetic field in this linearized theory. Its validity was estimated by evaluating critical times for the return current as well and comparing them with the critical beam times. (auth)

2877 PLASMA HEATING UP TO FUSION TEMPERATURES IN A HIGH-VOLTAGE THETA-PINCH. (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

A description is given of technical characteristics of a theta-pinch device designed for the study of the efficiency of shock wave compression as a function of other parameters like plasma density or discharge voltage. (GE)

Diagnostics

Refer also to abstract 3006.

2878 (COO-2233-4) THOMSON SCATTERING STUDY OF COLLISIONAL-SHOCK HEATED PLASMAS. Report No. 62. McNeill, D. H. (Columbia Univ., New York (USA). Plasma Lab.). 1973. Contract AT(11-1)-2233. 133p. Dep. NTIS $9.75.

Thesis.

Thomson scattering was used to obtain electron temperature and density profiles in deuterium plasmas produced by strong collisional shock waves. The transverse shock speeds were 3 to 25 cm/μsec in 50 to 100 mtorr deuterium. Ruby laser light was incident at a right angle to the axis in the midpoint of the annular gap of an electromagnetically driven coaxial shock tube and scattered light was collected at 90 degrees. Plasma created by reflecting a strong shock from a dielectric wall was also studied. It is found that the plasma electron temperature (10 to 30 eV) is much less than the ion temperature (100 to 500 eV) as is predicted by theory for the early life of the plasma. Electron–ion Coulomb collisional temperature relaxation does not occur during the times of observation (3 to 4 μsec). Electron heating in the plasma is caused primarily by Ohmic dissipation of currents in the shock structure and piston. Plasma densities (0.5 to 3.5×10^{16} cm^{-3}) agree well with shock theory predictions. For gas ionizing shocks, good agreement with collisional theory is found for the electron temperature. (auth)

2879 (FRNC-TH-455) THOMSON SCATTERING IN A CONFINED PLASMA CREATED BY IRRADIATING A SOLID WITH LASER IRRADIATION. Stenz, C. (Paris-11 Univ., 91-Orsay (France)). 1973. 108p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

The Thomson scattering of light by a plasma was used as a diagnostic method and for investigating transport phenomena and correlations in a plasma. The spatial resolution (1 mm^3) and temporal resolution (10 to 20 ns) obtained and the small perturbations introduced lead to a particularly suitable method for point measurements in laser-produced plasmas. This diagnostic was used to study the expansion and confinement of a plasma produced by irradiating a solid target with laser radiation in a mirror magnetic configuration. A device was developed for measuring the total intensity and spectral distribution (multichannel analyzer) of ruby laser light scattered through 90° for determining the density and electron temperature. (FR)

2880 (FRNC-TH-459) ABSORPTION OF A DENSE PLASMA IN THE X-UV REGION; APPLICATIONS TO STUDIES OF EXCITED STATE POPULATIONS AND THE X-RAY LASER. Carillon, A. (Paris-5 Univ., 75 (France)). 1973. 154p. (In French). Dep. NTIS (U. S. Sales Only) $10.75.

Thesis.

The absorption of x-uv radiation by a dense plasma produced by irradiating an aluminium target with a laser beam was studied. A new technique for measuring absorption was developed. As the lifetimes involved were very short, it was necessary to develop a synchronizing device acting between the plasma sample and the plasma source. The problem was resolved by using the same laser to produce the two generating beams. The sample possesses a self-emission which must be taken into consideration. This emission was introduced into the transfer equation. Normally, in absorption problems, this emission is neglected. The extent to which fluctuations occurred led to the application of a fairly rigorous statistical treatment. Theoretical investigations enabled the significance of the quantity measured using this new plasma diagnostic technique to be demonstrated. It was possible to establish that the upper transition levels of $2p^5\ ^1S_0 - 2p^5$ and $^3P_1^0$ of Al^{3+} ions were heavily overpopulated and very near to population inversion. Emphasis is given to the part played by double-electron recombination which leads through the intermediate of the Al^{4+} channel to off-equilibrium states. The overpopulations observed for an x-ray laser are discussed. (FR)

2881 (JAERI-M-5275) CALIBRATION OF THE NEUTRAL PARTICLE ENERGY ANALYZER AT THE ENERGIES FROM 0.3 TO 4.0 keV FOR MEASUREMENT OF ION TEMPERATURE OF PLASMAS. Kitamura, A.; Takahashi, K.; Yano, S. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 26p. (In Japanese). NTIS (US Sales Only).

A neutral particle energy analyzer was designed and constructed to measure the ion temperature of JFT-2. It consists of a charge-stripping cell in which hydrogen atoms emitted from the plasma are ionized, an electrostatic energy analyzer, and an ion detector. The method of calibration for the analyzer and the results, especially conversion efficiency of the charge-stripping cell, for the particle energies between 0.3 and 4.0 keV, are described. The calibration requires the absolute value of intensity of the neutral beam entering the neutral particle energy analyzer, which is given by measurement of the secondary electron current resulting from impingement of the beam onto an electrode of the Faraday cup. This technique is especially useful in the low energy

region (≤5keV). The conversion efficiency of the charge-stripping cell is in good agreement with that calculated from the charge-stripping and charge-exchange cross sections, in the range of 0.4 to 4 keV. (auth)

2882 (JAERI-M-5276) MEASUREMENT OF THE ION TEMPERATURE FOR THE DISCHARGE CONDITION CASE 2 IN JFT-2 (TOKAMAK DEVICE). Yano, S.; Shirakata, H.; Takahashi, K.; Kitamura, A.; Makino, T. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 24p. (In Japanese). NTIS (US Sales Only).

The energy spectrum of charge-exchanged neutrals emitted from the JFT-2 were analyzed. The problems in this measurement included the counting of neutrals detected with a neutral particle energy analyzer, shielding of the analyzer from magnetic fields due to the discharge current in JFT-2, disturbances due to the filling gases, and background of the x-rays. The ion energy distribution in the plasma obtained from the measured neutral particle energy distribution is maxwellian, with temperature about 200 eV at 74 and 84 ms after rise of the discharge current. This measured value of 200 eV is in fairly good agreement with that calculated from the scaling law, $Ti = 2.51 \times 10^{-3}\ a^{5}\ Ip$, where a and Ip are the plasma radius and the plasma current, respectively. The energy distribution of ions in the plasma is enhanced in the low energy region, corresponding to the ion temperature of about 100 eV; a colder plasma with temperature 100 eV thus probably surrounds the hot central ion column of about 200 eV. The number of neutral particles in the effective volume of plasma, which is in the solid angle viewed from the analyzer entrance slit, is estimated to be 2×10^{8}. (auth)

2883 (TRITA-EPP-73-17) POLARIZATION MEASUREMENT ON SPECTRAL LINES OF LOW INTENSITY AND SHORT DURATION. Danielsson, L.; Lindberg, L. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Oct 1973. 22p. Dep. NTIS (US Sales Only) $4.25.

Measurement of the polarization of spectral lines emitted from a plasma in a magnetic field can give valuable information about anisotropy of the electron velocity distribution. Technically this means measurement of the polarization of a weak, moving, three-dimensional light source of short duration. Careful design and adjustment of the optical and photoelectric equipment is necessary to avoid systematic error sources. The design and optimization of the equipment is discussed in detail. Measurements were made of helium lines at a helium density of about 10^{20} m^{-3} (5m Torr). (auth) (SW)

2884 ION BEAM PROBE DIAGNOSTIC SYSTEM FOR LABORATORY PLASMAS. Reinovsky, R. E. Troy, NY; Rensselaer Polytechnic Inst. (1973). 291p. University Microfilms Order No. 74-5154.

Thesis (Ph. D.).

Ion beam probing was shown to be a general purpose diagnostic tool for magnetically confined plasmas. A complete system was designed, constructed, and operated on a number of laboratory plasmas to demonstrate the applicability of beam probing to laboratory devices. The results demonstrate that the advantages of ion beam probing can be achieved with modest expenditure of time and resources. The various components of a complete beam probe system were investigated theoretically and experimentally for the first time. The results show that the beam probe system is dominated by electron impact ionization, as expected, that simple detectors have several limitations, and that the feedback controlled electrostatic energy analyzer demonstrates the spatial and time resolution expected from the theoretical analysis. The first multiple beam technique for ion beam probing was developed, leading to the first measurement of electron temperature with an ion beam probe. It was also demonstrated that fast, accurate, and simultaneous measurements of charged particle density, electron temperature, and plasma space potential are obtainable using this system. (Diss. Abstr. Int., B)

2885 THEORETICAL FOUNDATION OF A PROPOSED NEW METHOD OF THE OPTICAL DIAGNOSTICS OF POSITIVE COLUMN PLASMA IN GLOW DISCHARGE. Sprachta, A. (Research Inst. of Radio Communication, Prague). Czech. J. Phys.; 24: No. 4, 366-373(1974).

An integral equation was constructed which describes the image of cylindrically symmetric, longitudinally homogeneous transparent systems radiating in the optical region. As a base, the construction of the three-dimensional impulse response of a point light source was used. If an experiment is arranged so that it can be described by such an equation, radial variations of atomic concentration in different levels may be determined (e.g., in the positive column of the glow discharge). (auth)

2886 LASER FABRY–PEROT INTERFEROMETER FOR MEASUREMENT OF PLASMA DENSITY IN A NONSTATIONARY STREAM. Kadymov, A. Kh. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1531-1534(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 196-199(1973).

The construction and operation of an interferometer with photoelectric recording designed for measurement of electron density and its distribution in time and over the cross section of the stream of a pulsed plasma accelerator are described. The principal elements of the device are mounted on a thoroughly shock-insulated π-shaped welded frame 1.5 mm long. The equipment function of the inteferometer is determined during pulsed shift of one of the mirrors toward the other one. The interferometer allowed complete patterns of the electron density distribution with respect to the radius and with respect to time to be obtained for several operating modes of the plasma accelerator. (auth)

2887 INFRARED-OPTICAL TRANSDUCER. Zharkova, G. M.; Orishich, A. M.; Ponomarenko, A. G.; Soloukhin, R. I. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1545-1546(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 208-210(1973).

An instrument is described for the visualization of an infrared two-dimensional image. The sensing element of the instrument is a liquid-crystal layer ~5 μ thick. The substrate is a Lavsan film ~10 μ thick with a 30-Å layer of chromium deposited on it for the absorption of the incident radiation. The yoke with the sensing element is placed into a vacuum cavity in order to eliminate thermal convection. The instrument is used to record the structure of the output beam of a pulsed CO_2 laser. The measured sensitivity of the instrument is ~10 mJ/cm^2. (auth)

2888 INSTALLATION WITH MECHANICAL SCANNING FOR RECORDING THE SPECTRA OF LIGHT SCATTERED BY A PLASMA. Aksenov, V. A.; Eroshenko, V. M.; Mushinskii, A. A.; Pyatnitskii, L. N. (State Scientific-Research Power Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1547-1549(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 210-213(1973).

An experimental installation is described which is designed for recording the spectra of laser-radiation scattering by plasma electrons during one laser flash. The mechanical system used for wavelength sweep of the spectrum ensures a recording time equal to ~600 μsec. (auth)

2889 MEASUREMENT OF ELECTRON DENSITY IN A PLASMA USING CAVITY PERTURBATIONS IN A SINGLE LASER. Eylon, S. (Electronics Research Laboratory, University of California, Berkeley, California 94720). Rev. Sci. Instrum. 45: No. 3, 462-463 (Mar 1974).

A method is described for the measurement of electron density in a plasma using cavity perturbations in a single cavity, inexpensive commercial laser. The method is based on auto-interference of the sensing laser light at a given delay. A lower limit of 10^{13} electrons/cm^3 sec in the measurement of the rate of change in plasma density is expected in a practical system. (auth)

2890 A THIN FILM THERMOPILE FOR NEUTRAL PARTICLE BEAM MEASUREMENTS. Sharp, L.E.; Holmes, L.S.; Stott, P.E.; Aldcroft, D.A. (U K A E A Research Group, Culham Laboratory, Abingdon, Berkshire, England). Rev. Sci. Instrum. 45: No. 3, 378-381 (Mar 1974).

A simple design is described for a sensitive thin film thermopile (12 $V\ W^{-1}$) which is suitable for measurements on low energy neutral beams in the range 300 eV–3keV. The device has been used as a secondary standard to calibrate fast response ($\tau \sim 10^{-4}$ sec) neutral particle energy analyzers which incorporate gas stripping cells. (auth)

2891 DOUBLE PROBE MEASUREMENT OF ELECTRON THERMAL FLUCTUATIONS IN A PLASMA. el Shahid, N.A.; Deschamps, P.; Gravier, R.; Renaud, C. (Association Euratom–CEA Sur La Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, Boîte Postale No. 6, 92260 Fontenay-Aux-Roses, France). Rev. Sci. Instrum. 45: No. 3, 415-418 (Mar 1974).

A new simple differential technique using two Langmuir probes yields an analog signal proportional to the local electron temperature fluctuations in a plasma, even in the presence of density and potential fluctuations. By externally driving a periodic change in the plasma temperature, it has been possible to check this technique and its accuracy and to enable calibration. This differential technique is used to measure the amplitude fluctuations in a turbulent collisionless drift wave spectrum present in a laboratory plasma. (auth)

2892 MEASUREMENT OF TIME DEPENDENT ELLIPTICAL HIGH BETA PLASMA DEFORMATIONS BY MEANS OF HOLOGRAPHIC HF LASER INTERFEROMETRY. Braun, W. (Max-

Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 47A: No. 2, 144-146(11 Mar 1974).

Multi-wavelength holographic hf laser interferometry was developed and applied for the first time to measure plasma density profiles. An ellipticity of the plasma cross-section in the ISAR T1 theta-pinch-like high-beta stellarator was determined. Oscillations of the minor elliptical semi-axis were observed. (auth)

2893 RADIO-FREQUENCY PROBES IN A NONLINEAR ISOTROPIC PLASMA. Bantin, C. C.; Balmain, K. G. (Univ. of Toronto). Can. J. Phys.; 52: No. 4, 291-301(15 Feb 1974).

Nonlinear cold-plasma and scalar-pressure theories are derived and applied to a spherical rf probe in a plasma. With two specified rf potentials on the probe at different frequencies, calculations are presented for the second-order probe output responses. These include the second harmonic, the sum and difference frequencies, and the dc increment (resonance rectification). The nonlinear response as a function of frequency is shown to depend strongly on whether the input signals are maintained at a constant current or a constant voltage; for diagnostics, the constant-current technique permits identification of the plasma frequency, whereas the constant-voltage technique does not. (auth)

2894 INTERPRETATION OF CHARGE-EXCHANGE ION TEMPERATURE MEASUREMENTS IN TOKOMAKS. Parsons, C. R.; Medley, S. S. (Univ. of Texas, Austin). Plasma Phys.; 16: No. 3, 267-273(Mar 1974).

The interpretation of plasma ion temperature measurements obtained by energy analysis of the charge-exchange neutral atom flux from Tokamaks is refined through development of a Monte-Carlo computer code which simulates the charge-exchange process in a three-dimensional, unmagnetized plasma having variable density and temperature parameters. Analysis of the code-generated neutral energy spectra shows that the apparent two-temperature distribution often observed experimentally can be solely a consequence of plasma density and temperature gradients. Furthermore, this diagnostic may underestimate the actual maximum plasma ion temperature in certain cases. (auth)

2895 PLASMA DENSITY DETERMINATION. Balanis, G. N. (Applied Theory, Inc., Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-22: No. 1, 140-142(Jan 1974).

An approach to the indirect probing of inhomogeneous plane stratified plasmas is presented which, within numerical limitations, yields unique electron density profiles. It has been shown that the density profile and the reflected wave generated by a δ-function incident electric field are uniquely related by a Fredholm integral equation. The integral equation is solved numerically by transforming it to a matrix equation. The values of the reflected wave at equally spaced time points determine the matrix elements. As the interval between the time points is decreased, the electron density obtained from the inversion of the matrix equation approaches the actual density. To illustrate the method, profiles are obtained for some plasmas whose density is constant or a decreasing function. (auth)

2896 STANDARD WHEATSTONE BRIDGE TYPE CIRCUIT FOR PLASMA ELECTRON TEMPERATURE AND ELECTRON DENSITY MEASUREMENT BY A LANGMUIR PROBE. Pytlinski, J. T.; Manis, R. M.; Stentz, E. L. (South Florida Univ., Tampa). Arch. Procesow Spalania; No. 2, 195-197(1973).

A simple Wheatstone type circuit for measurement of electron temperature and electron density by a single or double Langmuir probe is described. Using this circuit, the voltage and the current from the probe can be determined with an accuracy higher than 1%. High input resistance of the bridge guaranties a very small value of the load current that the bridge will impose on the plasma during voltage measurement. The electric time constant of the bridge circuit is not small enough to allow this circuit to be used with nonquiescent plasma or in connection with an X-Y recorder. The bridge has proven to be an efficient tool of quiescent plasma measurements by a "step by step" method. These measurements were performed in a steady-state argon plasma with an electron temperature of 1 to 2 eV and an electron density of 10^8 to 10^{10} per cu cm. (auth)

2897 INTERFEROMETRIC MEASUREMENTS OF HIGH-DENSITY PLASMA. Appelt, J.; Czaus, K.; Sadowski, M.; Ugniewski, S. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 19: No. 1, 1-12(1974).

The main features are described of a Mach-Zehnder interferometer equipped with a pulsed ruby laser, that was used for measurements of electron concentration in a plasma produced by the F-20 coaxial injector. Interferograms of various stages of the discharge are presented, together with an appropriate time scale. A method of quantitative analysis of interferograms is described, and the results of computations are discussed. The results of measurements indicate that the F-20 injector is capable of producing a high-density plasma in the immediate vicinity of the end of the center electrode. The maximum density of the plasma is of the order of 10^{19} cm^{-3}. At the moment just before the peak compression, the region having plasma density higher than 10^{18} cm^{-3} is about 1.0 cm in length and less than 0.4 cm in radius. (auth)

Kinetics (General)

2898 (ANL/ACC-2) BIBLIOGRAPHY OF LITERATURE ON CONTROLLED FUSION COMPUTER PROGRAMS. Kopp, R. (comp.). (Argonne National Lab., Ill. (USA)). 21 Dec 1973. Contract W-31-109-eng-38. 55p. Dep. NTIS $5.75.

The bibliography contains literature dealing with computer programming of controlled thermonuclear reactions and plasma physics. Author and Corporate Author indexes are included. (MOW)

2899 (NP-19979) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-SIXTH SIX-MONTHLY PROGRESS REPORT, 1ST JULY-31ST DECEMBER 1973. (Sydney Univ. (Australia). School of Physics). 1973. 9p. (PR-26). Dep. NTIS (US Sales Only) $4.00.

Summaries are given of experimental work on plasma sources, hydromagnetic shock waves, rotating plasmas, ion cyclotrons, carbon dioxide lasers, and far infrared work. (AT)

2900 (TRITA-EPP-74-2) CURRENT LIMITING SPACE CHARGE SHEATHS IN A LOW PRESSURE ARC PLASMA. Babic, M.; Torven, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Elektronfysik). 23 Jan 1974. 45p. Dep. NTIS (US Sales Only) $5.25.

A low pressure arc becomes unstable for sufficiently large arc currents or low gas pressures (current limitation, arc starvation, arc chopping). A mercury arc is used with a long positive column and a current stabilizing external electric circuit. The arc current is increased very slowly at vapor pressures below 1m torr, and voltage pulses with large amplitudes and a typical duration of 10 μs develop over the arc. The ac-voltage distribution along the column is measured by external capacitive probes, and when the column is kept axially homogeneous, the voltage drops are found to be concentrated to a space charge sheath which forms a sharp and visible boundary across the column. For current levels just below the current leading to sheath formation, voltage pulses propagating with the ion sound speed can be detected in the region of the column where the sheath is formed. For very low gas pressures current limitation may be associated with theoretically predicted existence limits for a low pressure positive column. For slightly higher pressures, earlier theories for current limitation are found to be in disagreement with the experimental results. It is concluded that the fundamental processes leading to high-voltage space charge regions are not yet understood under actual discharge conditions. (SW)

2901 INVESTIGATION OF THE TRANSIENT PLASMA FLOW FROM A SELF-FIELD PINCH DISCHARGE. McKenna, K. F. University Park, PA; Pennsylvania State Univ. (1973). 138p. University Microfilms Order No. 74-4008.

Thesis (Ph. D.).

The transient plasma flow from a self-field pinch discharge was experimentally examined. The investigation was conducted utilizing a cylindrical Z-pinch, with 70 millitorr uniform argon fill pressure and reversible electrode polarity, in two configurations: (1) a solid chamber electrode geometry, and (2) an axial orifice in the outer electrode facing into an exhaust vessel. The 130 kA, 8 μsec duration, driving current pulse was approximately constant and non-reversing. Pressure, velocity, electric and magnetic field probes along with luminosity photography and total voltage probes were used to study the chamber source flow and the expansion flow into a 6-inch diameter exhaust vessel. (Diss. Abstr. Int., B)

2902 MINIMUM-POWER EFFECT OF A MAGNETIZED PLASMA. Lehnert, B.; Bergstroem, J.; Bures, M.; Holmberg, S.; Tennfors, E. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 9: No. 2, 108-118(Feb 1974).

An experimental and theoretical analysis is performed of a fully ionized, magnetized, quasi-steady plasma being separated from a surrounding neutral gas blanket by partially ionized boundary regions: (1) For rotating as well as high-frequency heated plasmas there exists a sharply defined minimum heating power P_m and temperature T_{em} below which a steady fully ionized state cannot be maintained. At laboratory dimensions and ion densities of about 10^{21} m^{-3}, these parameters become $P_m \simeq$ 0.5 MW and $T_{em} \simeq 2 \times 10^4$K. This "minimum-P effect" is impor-

tant both to the processes of creating and maintaining laboratory plasmas in fusion research and to the studies of certain cosmical plasmas. (2) The theoretically predicted behavior of the plasma is roughly in agreement with the experiments in the power range close to the minimum value. (auth)

2903 MODULATION OF A PROPAGATING ELECTROMAGNETIC WAVE IN THE REFLEX DISCHARGE PLASMA. Dushin, L. A.; Skibenko, A. I.; Serikov, A. V.; Fomin, I. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 99-105(Jan 1974). (In Russian).

Some measurements of the modulation were made in the reflex discharge plasma at low frequencies. It is shown that development of the density fluctuations provokes an anomalously rapid plasma decay. An attempt was made to estimate the effect of the magnetic field on the fluctuation. (auth)

2904 PREDICTIONS OF ARC TEMPERATURE PROFILES USING APPROXIMATE EMISSION COEFFICIENTS FOR RADIATION LOSSES. Lowke, J. J. (Westinghouse Research Lab., Pittsburgh). J. Quant. Spectrosc. Radiative Transfer; 14: No. 2, 111-122(Feb 1974).

Coefficients are calculated for the net emission of radiation per cc from the center of cylindrical isothermal plasmas of various temperatures and radii. Coefficients are given as a function of temperature and radius for the D lines of sodium vapor at 250 torr and for the continuum radiation of air at 1 and 30 atm. These coefficients are used in the Elenbaas–Heller equation to derive temperature profiles of wall stabilized arcs, e.g., for 4.5A with a radius of 0.35 cm in sodium vapor at 250 torr and 10,000 and 20,000A with a radius of 1 cm for air at 30 atm. Comparisons are made with calculated temperature profiles where self absorption effects and the radiation transfer are treated exactly, but still assuming thermodynamic equilibrium. It is found that the approximation using the net emission coefficients yields central arc temperatures and electric field strengths for a given arc current accurate to 10 per cent. Computation time for the approximate calculation is more than an order of magnitude less than for the calculation where radiation transfer is treated exactly. Thus the approximation facilitates an account of line radiation for arc plasmas having complex spectra. (auth)

2905 EFFECT OF TRAPPED BEAM ELECTRONS ON NONLINEAR BEAM-PLASMA INTERACTION. Jungwirth, K.; Piffl, V.; Ullschmied, J. (Ceskoslovenska Akademie Ved, Prague). Plasma Phys.; 16: No. 3, 283-302(Mar 1974).

The experimental and theoretical results of a study of the Cherenkov type ($\omega \approx k||v_b$) of nonlinear interaction of a cold electron beam with a magnetized plasma were discussed. In the initial stage, a single quasimonochromatic wave determining the dynamics of the nonlinear interaction was excited in the system. In this case the energy released by the retardation of the beam as a whole was transferred mainly to the excited wave and the problem may be solved numerically and simultaneously for any combination of ω_p^2, ω_{pb}^2, ν_p^2, V_b, $k||$ and k. Experimentally, the averaged beam distribution function in various stages of the interaction, the phase velocity of the excited wave and the spatial dependence of its amplitude were measured. Satellites of the basic wave were observed and their frequencies determined. In those regimes in which a single strong wave was excited an agreement between the calculated and measured values was found. If, however, the transit time of the beam electrons exceeded by a few reciprocal growth rates γ_L^{-1} the time interval necessary for reaching the first maximum of the basic wave amplitude, the excitation of satellite waves with comparable amplitudes but lower frequencies and the "overrelaxation" of the beam could be observed. A possible physical mechanism of this phenomenon was proposed. (auth)

2906 SYNCHROTRON RADIATION FROM A WEAKLY RELATIVISTIC ELECTRON PLASMA. Nicholson, D. R. (Univ. of California, Berkeley); Schwartz, M. J. Plasma Phys.; 16: No. 3, 275-282(Mar 1974).

Qualitative agreement was found between the experimental results of Lichtenberg et al (Lichtenberg, A. J., Schwartz, M. J. and Liebirman, M. A., Plasma Physics; 13: 89(1971)) and a model based upon the linear theory of synchrotron emission, absorption, and transmission in weakly relativistic plasma. (UK)

2907 RADIATION RESISTANCE OF A LINEAR CURRENT FILAMENT IN A DRIFTING MAGNETOPLASMA MEDIUM. (Seshadri, S. R. (Univ. of Wisconsin, Madison). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-21: No. 6, 890-893(Nov 1973).

The radiation resistance of a short current filament situated along the distinguished axis in a uniaxially anisotropic drifting magnetoplasma medium is evaluated for the case of a triangular distribution of current. The correction to the radiation resistance arising from a vanishingly small drift velocity of the plasma is found to be given by an additive term, which is essentially proportional to the drift velocity. (auth)

2908 ION ACCELERATION BY HIGH-FREQUENCY ELECTRIC FIELDS. Carretta, U.; Sindoni, E.; Tartari, U. Lett. Nuovo Cim.; 9: No. 16, 650-652(20 Apr 1974).

The results are described of a low-power experiment with the purpose of investigating the influence of the filling-gas pressure on the acceleration process, the ionic axial energy along the plasma column and its thermalization. The experiment is concerned with an Ar plasma created by an S-band rf power feeding a slotted line, immersed in a static magnetic-field gradient in ecr conditions. (MOW)

Kinetics (Experimental)

2909 (COO-2233-6) EXPERIMENTAL STUDY OF HOT PLASMA IN CONTACT WITH A COLD WALL. Feinberg, B. (Columbia Univ., New York (USA). Plasma Lab.). 1974. Contract AT(11-1)-2233. 120p. Dep. NTIS $9.00.

Thesis.

An experimental study was made of the energy transfer from a hot ($T \sim 5 \times 10^{5}$°K), dense ($n \sim 10^{16}$ cm^{-3}) deuterium plasma containing a strong magnetic field ($B \sim 10^{4}$ Gauss) brought into sudden contact with a cold wall. The energy flux from the plasma to the wall was measured using a thin film, fast rise-time bolometer. The construction, calibration, and theory of this bolometer are described. The experimentally measured energy flux was compared with a theoretical prediction employing classical plasma transverse thermal conductivity. The measured energy flux is found to be about 1.5 times that predicted by classical plasma theory. The measured plasma transverse thermal conductivity exhibits the functional dependence on temperature, magnetic field, and density that is expected from classical plasma theory. The extent of damage to the cold wall surface was also measured using a scanning electron microscope to examine various wall samples exposed to the plasma. The observed surface damage to a copper wall sample was in reasonable agreement with the predicted damage due to sputtering. The damage to the surface of a stainless steel wall sample was considerably greater than predicted by sputtering. (auth)

2910 INVESTIGATION OF THE EARLY STAGE OF DECAY OF ARGON PLASMA. Polyanskii, M.N.; Skrebov, V.N.; Shukhtin, A.M. Opt. Spectrosc. (USSR) 34: No. 2, 124-126 (Feb 1973).

The kinetics of volume processes in the early state of the decay of an argon plasma are studied. It is shown that the decay rate exceeds the rate of collisional-radiative recombination. The increase in the decay rate is determined by processes involving neutral argon atoms. (auth)

2911 EMISSION OF A CONTINUOUS SPECTRUM OF ELECTRON DECELERATION BY ATOMS IN THE POSITIVE COLUMN OF ARGON DISCHARGE. Golubovskii, Y.B.; Kagan, Y.M.; Komarova, L.L. Opt. Spectrosc. (USSR) 34: No. 2, 127-128 (Feb 1973).

The intensity of the continuous spectrum of electron deceleration by atoms in the positive column of an argon discharge is calculated by taking account of the actual energy distribution function of electrons. The calculated intensities are compared with the measured ones. (auth)

Kinetics (Theoretical)

2912 (IPPCZ-174) BEHAVIOUR OF A WEAKLY IONIZED GAS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. I. Description of Weakly Ionized Gas From Macroscopic Viewpoint: Continuum Theory. Vrba, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Nov 1972. 137p. INIS.

A set of equations expressing conservation laws of mass, charge, momentum, and energy together with the generalized Ohm law and the Maxwell equations are presented. Collision frequencies, friction coefficients, and coefficients of viscosity and heat conductivity are determined from the kinetic theory. When crossed electromagnetic fields are applied, a neutral gas is ionized and caused to rotate; the characteristic time of the process is determined. From the set of nine partial differential equations, best characterizing the behavior of a plasma in an axially symmetric vessel of a finite length, the following macroscopic quantities are found: plasma density, the radial and azimuthal components of the velocity vector, the radial and azimuthal components of current, the radial component of intensity of the electric field, and the plasma potential. A comparison with experiment was made; the values were in good agrement. (INIS)

2913 (IPPCZ-175) BEHAVIOUR OF A WEAKLY IONIZED GAS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. II. Description of Weakly Ionized Gas From a Microscopic Viewpoint: Kinetic Theory. Vrba, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Nov 1972. 67p. INIS.

The microscopic description of a mixture of a weakly ionized gas is based on a set of the Boltzmann equations solved by the Enskog-Chapman approximation method; the distribution functions are thus determined that characterize the behavior of the components of the mixture in space and time. Higher approximations than the second one are not given. The behavior of an ionized gas in the presence of electric and magnetic fields is analyzed considering internal states of molecules. Transport equations for molecular properties are given in the first approximation. The vector part of the second order correction is emphasized although equations determining all parts of the correction (scalar, vector, and tensor) are given. From the vector part of the correction, the relations are obtained necessary in obtaining the heat flux vector, the diffusion velocity and the current intensity. The relations are useful in investigating non-equilibrium processes (e.g., non-equilibrium ionization, etc.) (INIS)

2914 (JAERI-M-5376) PFIRSCH-SCHLUETER DIFFUSION IN A MULTICOMPONENT PLASMA. Tuda, T.; Tanaka, M. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 5p. (In Japanese). NTIS (US Sales Only).

The cross-field particle transport in a toroidal plasma with multiple ion species is studied. On the basis of the multi-fluid model the particle flux across the magnetic surface is calculated assuming a large aspect ratio. (auth)

2915 PARTICLE MOTION WITHIN A PLASMA OWING TO THE TRANSMISSION OF AN INTENSE ELECTROMAGNETIC PULSE. Case, W. (2121 East Genesee Street, Syracuse, New York 13210). Phys. Rev. A 9: No. 2, 925-928 (Feb 1974).

The motion of charged particles owing to an electromagnetic plane-wave pulse propagating in a dispersive region is considered. The calculation includes nonlinear and relativistic effects. It is argued that this solution may be viewed as a correction (for the motion of the particles) to the linear theory of propagation of an electromagnetic pulse within a plasma. The importance of such corrections is also considered. (auth)

2916 NONITERATIVE CALCULATION OF THE RADIAL DISTRIBUTION FUNCTION IN A HIGH-DENSITY CLASSICAL ELECTRON GAS. Mo, K.C.; Hooper, C.F. Jr. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32601). Phys. Rev. A 9: No. 2, 808-818 (Feb 1974).

It is the purpose of this paper to report a noniterative calculation of the classical electron-gas radial distribution function, for Γ values up to 10.0, that is both accurate and relatively inexpensive. The theoretical method uses collective coordinates in conjunction with a rapidly convergent perturbation expansion. Numerical results are presented in both tabular and graphical form. Systematic corrections are discussed. (auth)

2917 KINETIC EQUATION AND THE EQUATION OF MOMENTUM TRANSFER FOR A PLASMA. Majumdar, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Pramana; 1: 129-134(Sep 1973).

An attempt was made to derive a simple form of the collision integral of the kinetic equation for a plasma, by using Rostoker's (1964) equation which expresses the pair correlation function in terms of the distribution functions of the particles, and the conditional probability of one particle shielding the other. The conditional probability function is assumed to be given by its equilibrium value. By taking first order velocity-moment of the resulting kinetic equation, the equation of momentum transfer was obtained. (auth)

2918 GREEN-KUBO FORMULAE FOR PLASMA IN AN EXTERNAL MAGNETIC FIELD. Corkum, P. B.; McLennan, J. A. (Lehigh Univ., Bethlehem, PA). Can. J. Phys.; 52: No. 6, 516-522(15 Mar 1974).

The relation between linearized magnetohydrodynamics and the space and time dependent correlation functions of a plasma in an external magnetic field is derived. The method used is a perturbation technique based on the assumption that the correlation functions can be decomposed into a slow, hydrodynamic, and a rapid, microscopic, part. Using this method, the hydrodynamic modes are determined, and the description of magnetohydrodynamics found in this manner is assumed to be identical to regular magnetohydrodynamics. The resulting correspondence yields a set of correlation function expressions for the transport coefficients and magnetohydrodynamic modes. (auth)

2919 POTENTIAL OF A MOVING TEST CHARGE IN A COLLISIONAL PLASMA. Stenflo, L.; Yu, M. Y. (Umeaa Univ., Sweden). Phys. Scr.; 8: No. 6, 301-302(Dec 1973).

The perturbations due to a moving test charge in a collisional plasma are considered. A dipole-like potential is obtained and previous results are generalized. (auth)

2920 PROPERTIES OF THE COLLISIONAL PLASMA SHEATH WITH IONIZATIONS. Rosa, R. (Junta de Energia Nuclear, Sacavem, Portugal). J. Phys., A (London); 7: No. 4, 541-551(1 Mar 1974).

A simple model of a collisional plasma sheath, with ionizing collisions included and in contact with a negative metal wall, is proposed. A broad range of plasma sheath solutions is obtained and their properties are discussed. The characteristic of the abnormal glow discharge as well as the characteristic of the electrostatic probe, in the ion-saturation region, are incidentally recovered. This theory is then applied to the study of current multiplication in electrical discharges. The properties of a "plasma current multiplier" are predicted, both in the low and high pressure regimes, and are found to be in general agreement with the observed operating characteristics reported elsewhere. (auth)

2921 TRANSPORT PHENOMENA IN A PARTIALLY IONIZED LORENTZIAN MAGNETOPLASMA. Jayaram, S.; Lakhina, G.S. (Department of Physics, Indian Institute of Technology, New Delhi, India); Buti, B. Ann. Phys. (N.Y.) 80: No. 1, 42-59 (Sept 1973).

Some transport coefficients are evaluated for a homogeneous, partially ionized Lorentzian plasma in the presence of a uniform external magnetic field. The electron-ion collisions are taken into account by means of the modified Fokker-Planck equation and the electron-neutral collision frequency, ν_{en} is taken as velocity (ω) dependent or velocity independent, depending on the energy range under consideration. The variation of the transport coefficients with magnetic field is determined for $\nu_{en} \propto \omega^s$ (s being a positive or negative integer) and one finds that qualitatively this behavior does not change by changing either the collision frequency or the velocity dependence of the collision frequency; however for weak magnetic fields the magnitudes of these transport coefficients increase with the decrease in ν_{en} or s, whereas for strong magnetic fields the transverse components of the transport coefficients decrease and the Hall components tend to saturate with the decrease of either the collision frequency or s. (auth)

2922 HIGH FREQUENCY CONDUCTIVITY OF A MAGNETIZED PLASMA WITH FLUCTUATIONS. Chen, L. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Lett.; 47A: No. 3, 229-230(25 Mar 1974).

A general expression is derived for the longitudinal current density induced by a high-frequency, uniform, external electric field in a uniformly magnetized, fully ionized plasma with low-frequency fluctuations. (auth)

2923 FAR-FIELD POTENTIAL OF A TEST CHARGE IN AN INHOMOGENEOUS AND MAGNETIZED PLASMA. Shukla, P. K.; Spatschek, K. H.; Yu, M. Y. (Ruhr-Univ., Bochum, Ger.). Can. J. Phys.; 52: No. 3, 281-283(1 Feb 1974).

It is shown that a stationary test charge in a magnetized inhomogeneous plasma has a far-field potential which falls off as the inverse cube of the distance between the test charge and an observer who is located in a direction perpendicular to both the density gradient and the external magnetic field. On the other hand, the effect of an external magnetic field parallel to the velocity of a slowly moving test charge in a homogeneous plasma is shown to be insignificant. (auth)

2924 HYDRODYNAMIC THEORY OF THE STABILITY OF A SELF-FOCUSSING RELATIVISTIC BEAM. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Commission, Cairo). Plasma Phys.; 16: No. 3, 303-315(Mar 1974).

The stability of a self-focusing relativistic electron beam (REB) was investigated in a quasi-hydrodynamic approximation. It was demonstrated that the inclusion of density inhomogeneity of the REB particles leads to a nonlinear relationship between longitudinal transverse electron motion. The analysis indicated that the amplitude of electron transverse displacement increased sharply within a certain range of REB parameters which might be interpreted as a specific instability. The energy of electron transverse oscillations increased at the expense of the energy of longitudinal oscillations, which, in their turn, acquire their energy from that of the REB translational motion. The conditions for instability and growth rate of unstable oscillations were obtained. It is also shown that nonlinear interactions between high-frequency electron and low-frequency ion oscillations result in the increase of ion oscillation amplitude. (auth)

2925 THREE ELECTRON POPULATIONS MODEL FOR CURRENT CARRYING PLASMAS. Coppi, B.; Pozzoli, R. (Massachusetts Inst. of Tech., Cambridge). Plasma Phys.; 16: No. 3, 223-245(Mar 1974).

Three typical electron populations were distinguished in a high temperature two-dimensional toroidal plasma; those that carried current under the influence of an externally applied electric field, those that could circulate but do not carry appreciable current, and those that were trapped. Traveling modes, along the magnetic field lines, with frequencies larger than the transit frequency of thermal electrons could be excited when the distribution function of the first population tended to detach itself from that of trapped and weakly circulating electrons, assuming that it could be represented by a beam-like distribution with its contour in velocity space chosen in such a way as to take into account the influence of magnetic trapping. The effects of these modes could be compared to those of electron–electron collisions. The trapped and barely circulating electrons were strongly affected by standing "quasi-banana" orbits whose radial amplitudes were larger than those of the known "bananas." The collisional diffusion which may be associated with these orbits could have an expression similar to that of the experimentally observed "pseudoclassical" diffusion of electron thermal energy. (auth)

2926 HELICOIDAL APPROXIMATION FOR GENERAL NON-SYMMETRIC CLOSED PLASMA CONFIGURATIONS. Luc, H.; Maschke, E. K.; Mercier, C.; Misguich, J. H.; Rizk, R. M. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 16: No. 5, 455-478(May 1974).

A general class of equilibria shows helicoidal symmetry in the vicinity of the magnetic axis. The conditions in which this helicoidal symmetry could be considered as a very good approximation for the whole plasma ring when the latter was located around a closed curve with variable torsion and curvature were deduced. Equilibrium and stability were then studied for a helicoidal bent and twisted plasma with a two-variable helicoidal symmetry. These equilibria were in fact a generalization of axisymmetric configurations and therefore have magnetic surfaces to a good approximation. As particular cases, the work of course described the equilibrium and stability of toroidal machines like Tokamak, but also applied to Harmonica 2. In the general case these configurations were of the Stellarator type but with a non-planar magnetic axis; the usual Stellarators thus do not belong to the present class. (auth)

2927 STATIONARY AND QUASISTATIONARY SOLUTIONS OF A GUIDING-CENTER PLASMA. Knorr, G. (Univ. of Iowa, Iowa City). Plasma Phys.; 16: No. 5, 423-451(May 1974).

A guiding-center plasma has stationary solutions in cartesian and cylindrical geometries. Most of them are unstable and evolve in such a way that most energy concentrates at low wave numbers. This is a consequence of conservation of energy and the square of the vorticity. Explicit solutions of the truncated model were given. Manley-Rowe relations were derived and related to the constraints of the system. (auth)

2928 CONTRIBUTION TO THE STATISTICAL RELATIVISTIC TRANSPORT THEORY OF A CLASSICAL PLASMA. Veretennicoff, I. Brussels; Univ. Brussels (1973). vp. Centre d'Etude de l'Energie Nucleaire, Mol, Belgium.

Thesis.

Three basic concepts of the kinetic theory were applied to nonrelativistic systems. The "subdynamics" concept allowing for the algebraic elaboration of a general kinetic equation, then the correlation pattern concept, and finally, the concept of hydrodynamical normal modes, seen as an extension in the hydrodynamical domain of the zero eigenvalues of the homogeneous collision operator. The extension of these concepts and their application to the relativistic case have not been trivial. One of the reasons is to be found in the continuous character of the wave vector "labelling" the field oscillators. But the main reason is that electromagnetic interactions provide the plasma with quite a singular status, i.e., it has nine "hydrodynamical" modes, four of them become pure plasma waves in the limit of a homogeneous system, and two do not at all contribute on hydrodynamical length scales. It was shown that these new features can be understood, in the microscopic picture, as the result of two symmetry breakings with respect to the nonrelativistic theories. (auth)

2929 INFLUENCE OF QUANTUM EFFECTS UPON HIGH-FREQUENCY CONDUCTION OF WEAKLY NON-IDEAL PLASMA. Istomin, V. V.; Sher, S. P.; Dovgopol, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 9, 1560-1562(Sep 1973). (In Russian).

The Landau equation, with consideration of the first quantum correction in the interval of collisions proportional to the square of the Planck constant, was used for the determination of the electroconductivity of weakly non-ideal plasmas in weak homogeneous and variable electric fields under the condition that the effective collision frequency in the plasma is significantly lower than the frequency of the external field. It was shown that the influence of the quantum effect increases the dissipation part of the conductivity and decrease its imaginary part. (tr-auth)

2930 TWO-STREAM INSTABILITY STUDIES WITH FOUR ONE-DIMENSIONAL PLASMA SIMULATION MODELS. Brown, D. I. (Univ. of Pennsylvania, Philadelphia); Gitomer, S. J.; Lewis, H. R. J. Comput. Phys.; 14: No. 2, 193-199(Feb 1974).

Four one-dimensional plasma simulation models were compared with regard to the electrostatic two-stream instability. The primary reason for making these comparisons was to determine the extent to which physical results depend on numerical method for a problem in which collective effects dominate. Previously, Lewis, Sykes, and Wesson compared these four simulation models using a stable double-streaming situation as a test problem. In that case the comparisons were with regard to collisional effects, energy conservation, and momentum conservation; however, because a stable test problem was used, only tentative conclusions could be drawn as to the comparison among the models when they are applied to a problem in which collective effects dominate. We have applied the models to compute the evolution of a two-stream instability and compared the time dependence of the electric energy as determined by each of the models. The models are characterized by the representation of the electric potential and by how the electric field is computed from the potential; both linear and quadratic splines are used to represent the potential or field. The major result of the comparisons is that the evolution of the electric energy of a two-stream unstable plasma does not depend strongly on the choice of model. There is a much stronger dependence on the random numbers that are chosen to represent the initial distribution function in phase space. (auth)

2931 QUIET HIGH RESOLUTION COMPUTER MODELS OF A PLASMA. Hockney, R. W.; Goel, S. P.; Eastwood, J. W. (Reading Univ., Eng.). J. Comput. Phys.; 14: No. 2, 148-158 (Feb 1974).

Two new computer models are introduced in which the influence of the finite potential mesh is, for most practical purposes, eliminated. The Quiet Particle-Mesh model (QPM) uses a Gaussian-shaped charge cloud and careful shaping of the potential solution in either real or transform space. The QPM model is measured to be 150 times less noisy than the conventional CIC model and is suitable for large collisionless plasma simulations with 10^5 or more particles. This is achieved at little or no cost in computing time. The hybrid Particle–Particle/Particle–Mesh model (PPPM), on the other hand, adds to the above mesh calculation contributions from nearby particles by direct summation. This model has a spatial resolution which is independent of the mesh spacing and may be a small fraction of a mesh cell. It is more time-consuming and is suitable for high-resolution sub-Debye length investigations with a smaller number of particles ($\sim 10^4$). Applied to molecular dynamics, the PPPM model can simulate systems with approximately 100 times the number of particles than conventional methods. (auth)

2932 REDUCTION OF THE GRID EFFECTS IN SIMULATION PLASMAS. Chen, L.; Langdon, A. B.; Birdsall, C. K. (Univ. of California, Berkeley). J. Comput. Phys.; 14: No. 2, 200-222(Feb 1974).

The electromagnetic field grids in fine-resolution two-dimensional or medium-resolution three-dimensional plasma simulation are very large. A method is proposed whereby only a fraction of the grid need be in fast core at any given time. The basic idea is to do several consecutive field solutions with coarse grids displaced relative to one another. The separate solutions may pertain to different time steps ("jiggling") or the same time step ("interlacing"). The combination of these separate solutions can provide some aspects of the accuracy improvement obtainable with the fine grid which is the superposition of the separate grids. These techniques may be useful when one is strongly limited by the size of random-access memory but can afford to place greater demands on serial-access memory and processor speed. Their effect is to reduce "aliasing" errors, in which plasma perturbations are unphysically coupled when their wave numbers differ by wave vectors characteristic of the grid. Resolution may then be improved by methods described elsewhere. In order to evaluate these methods quantitatively, dispersion relations for plasma oscillations are examined. Aliasing effects, such as grid-induced instability, can be greatly reduced. However, depending on the smoothness of the velocity distribution, "jiggling" can introduce new troublesome modes with frequencies $\sim \Delta t^{-1}$; "interlacing"

has no known ill side effects. Simulation results are in agreement with theory. In two and three dimensions, there is also a decrease in computation time compared to using a finer grid with similar reduction in grid effects. (auth)

2933 COMMENT ON "AMBIPOLAR DRIFT, DEFORMATION, AND DIFFUSION OF A PLASMA IN A MAGNETIC FIELD" BY RICHARD L. MONROE. Byrne, J. C. (Univ. of Western Australia, Nedlands). Can. J. Phys.; 52: No. 1, 94(1 Jan 1973).

When the displacement current is negligible in Maxwell's equations an additional assumption of charge neutrality is not a redundant assumption, as was recently claimed by Monroe, for a plasma in a magnetic field when there are no externally maintained electric fields. (auth)

2934 REPLY TO COMMENT BY J. C. BYRNE ON "AMBIPOLAR DRIFT, DEFORMATION, AND DIFFUSION OF A PLASMA IN A MAGNETIC FIELD." Monroe, R. L. Can. J. Phys.; 52: No. 1, 95(1 Jan 1973).

It is argued that for a plasma in a magnetic field where there are no externally maintained electric fields, that neglect of displacement currents in Maxwell's equations implies charge neutrality. (CA)

2935 INTERCOMPONENT MOMENTUM TRANSPORT AND ELECTRICAL CONDUCTIVITY OF COLLISIONLESS PLASMA. Wilhelm, H. E. (Colorado State Univ., Fort Collins). Can. J. Phys.; 51: No. 24, 2604-2611(15 Dec 1973).

Based on the Lenard–Balescu equation, the interaction integral for the intercomponent momentum transfer in a two-component, collisionless plasma is evaluated in closed form. The distribution functions of the electrons and ions are represented in the form of nonisothermal, displaced Maxwellian corresponding to the 5-moment approximation. As an application, the transport of electrical current in an electric field is discussed for infrasonic up to sonic electron–ion drift velocities. (auth)

2936 COMPUTATIONAL PHYSICS. Abstract. Biskamp, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

Assuming certain approximations it is possible to simulate the time behavior of a plasma using a computer and given initial conditions. In order to interpret a certain experiment and to derive predictions for similar systems, programs are developed which take into account as many phenomena and processes occurring in this experiment as possible. A program is described that simulates the development of the temperature, density, magnetic field, etc., in a tokamak discharge. These computations revealed among others that in this case the plasma loss due to the magnetic field is ten times higher than could be expected from particle collisions, and that this cannot be explained by the effect of probable impurities. In order to elucidate this anomalous plasma diffusion, one has to investigate the microscopic processes, i.e., the behavior of the ions and electrons. This can be done by representing the plasma in the computer by a very large number of particles, the movement of which is determined by their self-consistent fields. The principles underlying such particle computations are briefly outlined. They reveal, above all, information on the occurrence of plasma turbulences and their effect on transport properties such as conductivity and diffusion, i.e., on processes which are difficult to describe due to the complicated particle dynamics. (GE)

Production

Refer also to abstract 2879.

2937 (AD-769218) INFLUENCE OF HIGH-DENSITY PLASMAS ON SERIES MERGING. Davis, J. (Naval Research Lab., Washington, D. C. (USA)). Oct 1973. 20p. (NRL-MR-2655). NTIS $2.75.

A brief discussion of the basic mechanisms leading to spectral line series termination is presented for application to laser-generated plasmas. Numerical results are given for oxygen and copper. (auth)

2938 (SLA-73-954) LASER-FUSION RESEARCH PROGRESS REPORT, JANUARY–JUNE 1973. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. Contract AT(29-1)-789. 39p. Dep. NTIS $5.00.

Summaries of research during this period are given for the following: (1) glass laser systems, (2) laser-plasma interaction studies, (3) gas laser research, (4) chemical laser research, and (5) theory. (MOW)

2939 (TRITA-EPP-74-6) BREAKDOWN AND PLASMA FORMATION IN A ROTATING PLASMA DEVICE. Bonnevier, B.; Sillesen, A. H. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Mar 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Breakdown and formation of a plasma with high ion temperature were studied in the Puffatron. The conditions for plasma formation are understandable along the same lines as breakdown in an ordinary crossed field discharge, Penning, PIG, or magnetron discharge where ions are not magnetically confined, as in the present experiment. The growth of ionization occurs much faster than expected from ionization by thermal electrons. This has earlier been seen in some rotating plasma experiments. It is suggested that work along the present lines can result in a time independent arc discharge, where ions have thermonuclear energies. (SW)

2940 LASER TARGET MODEL. Winsor, N.K. (Naval Research Laboratory, Washington, D.C. 20375); Tidman, D.A. Phys. Rev. Lett. 31: No. 17, 1044-1046 (22 Oct 1973).

Results of a numerical simulation model are presented. Internally generated megagauss magnetic fields are produced which tend to impede and deform the heat flow into the target plasma beyond the laser-energy deposition layer. Two new instabilities are also discussed. (auth)

2941 STIMULATED EMISSION OF X RAYS FROM PLASMAS GENERATED BY SHORT-PULSE-LASER-HEATING OF SOLID TARGETS. Jha, S. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 1: 88-97(Aug 1973).

The heating of a solid target to generate a nonequilibrium plasma by subnanosecond laser pulses is considered. For an appreciable absorption of energy from a Nd-glass laser, the critical density of the electrons in the plasma turns out to be $10^{21}/cm^3$. These electrons can be heated up to 10,000,000°K or more by using pulses of about 10 picosecond duration. Starting from neutral atoms in a solid with a high atomic number, e.g., Z = 26, for times in the picosecond regime the relevant rate equations are solved analytically to predict densities of the atoms at different ionization levels. It is shown that during such a short time the population density of ions isoelectronic to neon builds up to a very large amount. This in turn leads to the population inversion in the 4s to 3p soft x-ray laser transition, via the electron-impact excitation of the 4s level of the isoelectronic neon ion. (auth)

2942 APPARATUS FOR PRODUCING LASER TARGETS OF 50 μ DEUTERIUM PELLETS. Jarboe, T.R.; Baker, W.R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Rev. Sci. Instrum. 45: No. 3, 431-433 (Mar 1974).

Apparatus is described which produces 50 μ deuterium pellets that are being used in a laser produced plasma facility. The pellets are sliced from a continuously spun solid deuterium thread at a rate of up to 10 pellets/sec. The methods of thread production and slicing, and pellet collimation are discussed. A unique feature of the apparatus is that it uses no liquid helium. (auth)

2943 MECHANISM FOR GENERATION OF PLASMA JETS FROM REFERENCE POINTS OF THE ARC DISCHARGE IN VACUUM. Nagaibekov, R. B. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 60-62(1973). (In Russian).

A mechanism based on the occurrence of microexplosions in cathode points of the arc discharge in vacuum is proposed for the mechanism of the generation of plasma jets. Ions formed as a result of ionization by electron collisions in the cathode vapor are the basic energy source for the plasma. (JSR)

2944 LASER- AND ELECTRON-BEAM THERMONUCLEAR FUSION CONCEPT. Winterberg, F. (Univ. of Nevada, Reno). Atomkernenergie; 22: No. 4, 262-267(1974).

A comparison of the laser- and electron-beam fusion concept is presented. The main advantage of the laser method is the prospect of strong pellet compression due to the perfection of the optical focusing apparatus. The main disadvantage of the laser concept is the low efficiency and high cost of the beam generation. Furthermore, presently available laser systems promising to meet the high power and energy requirements work in wave-length domains where the laser plasma coupling efficiency is rather poor. In contrast to laser beams, electron beams are easy to produce and about 10^3 times cheaper than laser beams of the same energy output. Furthermore, electron beams can carry very large self-magnetic fields making possible a pulsed magnetic confinement of the thermonuclear target resulting (a) in substantial reduction of the heat conduction losses for tamped targets, (b) a quenching of the charged fusion products within a small volume and (c) delaying the expansion losses. All three effects promise a substantial re-

duction of the minimum energy input required for a positive energy balance in a repetitive cycle of thermonuclear micro-explosions. In addition, the strong self magnetic beam field may also lead to a substantial target compression as envisioned in the laser method. Another advantage of the electron beam method is the experimentally reported excellent coupling of the beam with the thermonuclear target. The main disadvantage of the electron beam method is the rather long pulse length, as compared with the laser beam method. There is, however, the justified hope that these limitations can be overcome by the principal of magnetic insulation, making possible electron beams of very high voltage and thus short pulse length. (GE)

2945 TEMPERATURE AND DENSITY OF AN EXPANDING LASER PRODUCED PLASMA. Rumsby, P. T.; Paul, J. W. M. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 16: No. 3, 247-260(Mar 1974).

The density and temperature of an expanding laser-produced carbon plasma were measured over a large range of distances by several different methods. The density of an expanding element was found to have a time dependence $n_e \propto t^{-3}$. The electron temperature of the same element was found to decay with a dependence $Te \propto t^{-1}$ rather than the theoretical adiabatic $Te \propto t^{-2}$. These results confirm theoretical predictions about the effect of three body recombination on the cooling of a laser produced plasma. (auth)

2946 POSSIBILITY TO PRODUCE INTENSE RELATIVISTIC ELECTRON BEAMS BY MEANS OF A CHEMICAL EXPLOSION. Winterberg, F. (Univ. of Nevada, Reno). Atomkernenergie; 22: No. 3, 199-204(Dec 1973).

A method is described which promises the generation of very intense relativistic electron beams. This method is based on the combination of a magnetic flux compression device with a type of high voltage transformer. The magnetic flux compression is performed by a chemical high explosive. Besides inducing a high voltage, the strong magnetic field reduces the electric breakdown from the high voltage column. The high voltage column is connected to a Blumlein transmission line which is charged up to a high electrostatic potential. The electric energy stored in the Blumlein line is subsequently discharged over a field emission diode, resulting in an intense relativistic electron beam. If the beam is directed onto thermonuclear material, it dissipates its energy by collective beam–plasma instabilities. The total beam energy output can probably be made sufficiently large to ignite a thermonuclear detonation. The size of the trigger mechanism is so large that it does not seem to be competitive with fission triggers for military applications. Its significance is in the Plowshare field, where fissionless trigger devices are highly desirable. (GE)

Stability

Refer also to abstracts 2871, 2874, and 2930.

2947 (AD-769664) ROTATIONAL STABILIZATION IN AXIAL FLUX COMPRESSION EXPERIMENTS. Book, D. L.; Winsor, N. K. (Naval Research Lab., Washington, D. C. (USA)). Nov 1973. 16p. (NRL-MR-2643). NTIS $2.75.

The imploding metallic liner used in cylindrical flux compression experiments can be Rayleigh–Taylor unstable. Stabilization by rotation of the liner was investigated. It is shown that one can either remove the instability or limit its amplitude to a chosen value by selecting the rotation speed. The cost in conversion efficiency (initial energy into compressed magnetic field energy) of the stabilization is calculated. (auth)

2948 (IPPCZ-179) SOME NONLINEAR PHENOMENA ASSOCIATED WITH HIGH-FREQUENCY BEAM–PLASMA INSTABILITIES. Piffl, V.; Sunka, P.; Ullschmied, J.; Jungwirth, K.; Krlin, L. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Feb 1973. 20p. INIS.

High-frequency instabilities in a beam–plasma system were investigated experimentally. The measurements were performed on two experimental facilities. In one of them (beam current ≤ 50 mA at 5 kV) the plasma is created independently of the beam and in the range of parameters examined, only the instability with $\omega > \omega_{ce}$ is excited. In the other facility, the plasma is created by the electron beam itself (beam current up to 500 mA at 3 kV) and the process of the plasma buildup, up to the densities when $\omega_{pe} \approx \omega_{ce}$, is influenced only by the instability at frequencies $\omega < \omega_{ce}$. The working gas is argon. In both cases, the plasma is immersed in a homogeneous magnetic field ($\leq$800 G and 2000 G, respectively) and the number density of the plasma varies within the limits 10^9 to 10^{12} cm^{-3}. (auth)

2949 (IPPJ-159) APPROACH TO MHD EQUILIBRIUM OF VARIOUS PLASMA CROSS SECTIONS. Suzuki, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1973. 20p. NTIS (US Sales Only).

A simple diffused-boundary model is presented for magneto-hydrodynamic equilibrium in straight plasma and toroidal plasmas with various plasma cross sections. Many examples of simple analytical solutions are given and the relation between the geometrical factors and plasma parameters is obtained for each example. (auth)

2950 (N-72-32689) INSTABILITIES AND TURBULENCE IN HIGHLY IONIZED PLASMAS IN A MAGNETIC FIELD. Final Report, 1 March 1970–30 April 1972. Jennings, W. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Aug 1972. 34p. (NASA-CR-128297). NTIS $3.75.

Physical mechanisms were considered which are responsible for plasma turbulence and the establishment of necessary conditions for energy exchange and transfer in the frequency spectrum. In addition, work was performed to better understand the drift instability in the highly inhomogeneous Rensselaer arc, and methods to suppress this instability using feedback stabilization techniques. Correlation techniques were refined to study plasma turbulence, the diffusion wave technique for monitoring cross-field diffusion was extended to include regimes of high turbulence levels, and a technique for coupling stabilizing rf power to the Rensselaer arc was developed. (auth)

2951 GROWTH AND SATURATION OF THE ABSOLUTE ELECTRON-CYCLOTRON DRIFT INSTABILITY. Stenzel, R.L.; Ripin, B.H. (University of California, Los Angeles, California 90024). Phys. Rev. Lett. 31: No. 26, 1545-1548 (24 Dec 1973).

The electron-cyclotron drift instability is observed to develop an absolute instability in the laboratory frame of stationary electrons. We investigate the threshold, temporal and spatial growth, and the saturation mechanism. (auth)

2952 OBSERVATION OF PARAMETRIC INSTABILITY INDUCED BY BEAM-PLASMA INTERACTION. Parker, R.R.; Throop, A.L. (Research Laboratory of Electronics and Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 31: No. 26, 1549-1552 (24 Dec 1973).

A convectively unstable beam–plasma wave is excited and observed to grow and saturate. In the saturation region, the beam wave excites by parametric interaction an ion–acoustic wave and a backward–propagating Trivelpiece–Gould mode. Significant energy is deposited into these modes, and this suggests that pump depletion may play a role in the saturation process. (auth)

2953 EXPERIMENTAL OBSERVATION OF THE NONOSCILLATORY PARAMETRIC INSTABILITY AT THE LOWER-HYBRID FREQUENCY. Chang, R.P.H. (Bell Laboratories, Murray Hill, New Jersey 07974); Porkolab, M. Phys. Rev. Lett. 31: No. 20, 1241-1244 (12 Nov 1973).

The nonoscillatory parametric instability is observed when the "pump" frequency is near the lower-hybrid frequency. Strong heating of both the ions and electrons has also been measured. (auth)

2954 OBSERVATION OF DRIFT INSTABILITY DUE TO PARTICLE TRAPPING IN A CORRUGATED GEOMETRY. Deschamps, P.; Gravier, R.; Renaud, C.; Samain, A. (Association EURATOM—Commissariat à l'Energie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, 92260 Fontenay-aux-Roses, France). Phys. Rev. Lett. 31: No. 24, 1457-1460 (10 Dec 1973).

A drift instability due to electrons trapped in a series of shallow magnetic troughs has been observed and compared to theoretical estimates. The instability, identified as Kadomtsev's trapped-electron mode, is maximum at a density lower than estimated from the theory. (auth)

2955 PLASMA MODES DUE TO IMPURITY AND MAGNETICALLY TRAPPED IONS. Coppi, B. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 31: No. 24, 1443-1446 (10 Dec 1973).

The effects of unstable modes, connected with the presence of impurity ions in a magnetically confined high-temperature plasma column and not dependent on wave-particle resonances that involve only a small portion of velocity space, are discussed for two significant regimes: a collisional one corresponding to relatively short mean free paths of the main ion population and a collisionless one in which a significant fraction of this population is magnetically trapped. (auth)

2956 PARTICLE TRAPPING IN MAGNETIC LINE CUSPS. Boozer, A.H.; Levine, M.A. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730). Phys. Rev. Lett. 31: No. 21, 1287-1291 (19 Nov 1973).

A computer study of the magnetic line cusp with an internal field shows that a large fraction of the particles in the field-plasma boundary move in definite guiding-center orbits. In the absence of microinstabilities such particles will remain trapped between Coulomb collisions. Since only boundary particles can escape from a "stuffed" line cusp, this result gives an optimistic assessment of line cusps for fusion. (auth)

2957 TEMPORAL EVOLUTION OF A THREE-WAVE PARAMETRIC INSTABILITY. Rosenbluth, M.N.; White, R.B.; Liu, C.S. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. Lett. 31: No. 19, 1190-1193 (5 Nov 1973).

We solve exactly the temporal evolution and spatial dependence of a three-wave parametric instability in an inhomogeneous plasma. An initial fluctuation develops into a pulse and grows initially with the same growth rate as it would in a homogeneous plasma. Growth continues until convection saturation occurs. The pulse broadens as it grows and eventually assumes the form of a totally amplified region flanked by two shock fronts. Effects of damping are also discussed. (auth)

2958 TEMPORALLY GROWING RAMAN BACKSCATTERING INSTABILITIES IN AN INHOMOGENEOUS PLASMA. Drake, J.F.; Lee, Y.C. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 31: No. 19, 1197-1200 (5 Nov 1973).

We derive the equations describing the decay of an intense, coherent electromagnetic wave into a backscattered electromagnetic wave and a plasma wave in an inhomogeneous plasma. The plasma wave and scattered electromagnetic wave are trapped in the vicinity of their cutoffs near $\omega_p = \omega_0/2$. The resulting temporally growing instabilities may explain the strong heating and the blowoff observed in recent computer simulations of Raman scattering. (auth)

2959 EFFECT OF SIDE-SCATTER INSTABILITIES ON THE PROPAGATION OF AN INTENSE LASER BEAM IN AN INHOMOGENEOUS PLASMA. Klein, H.H.; Manheimer, W.M.; Ott, E. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 31: No. 19, 1187-1190 (5 Nov 1973).

Two-dimensional simulations of laser-plasma interactions in inhomogeneous media have been performed and clearly demonstrate that inhomogeneity effects can be strongly stabilizing for backscatter instabilities but may not be for sidescatter. The nonlinear evolution of the sidescatter is followed and indicates the possibility of very strong anomalous scattering of the incident laser light. (auth)

2960 COMPUTER CONTROLLED FEEDBACK STABILIZATION OF AN MHD PLASMA INSTABILITY. Merckel, G. U. Knoxville, TN; Univ. of Tennessee (1973). 164p. University Microfilms Order No. 74-3851.

Thesis (Ph. D.).

A general MHD plasma model is utilized to describe the spatial-time dependent behavior of a plasma surface perturbation. The computer control system introduces feedback effects through the activation of azimuthal currents causing additional transverse magnetic fields which act to restore the plasma deformation. An energy density imbalance condition based upon the theme of a Z-θ plasma pinch is developed to characterize this phase of the transient. Consideration is given to the temporal properties of the computer control system, the resident control algorithm, and the time delays associated with the control magnetic fields. Sensor based computer control systems whose temporal properties are one order magnitude faster than available today appear to be capable of providing timely control actions through feedback stabilization to control a thermonuclear plasma. The confinement time of the thermonuclear plasma is dependent on the methodology of the on-line control algorithm. An on-line control algorithm based solely on optimal control theory is unsatisfactory in confining the fusion plasma. On-line algorithms employing optimal control theory with state error corrections and state error feedback only provide control sequences which confine the thermonuclear plasma for time periods on the order of 100 microseconds. (Diss. Abstr. Int., B)

2961 PARAMETRIC EXCITATION OF UPPER HYBRID AND DIFFUSION MODES IN A MAGNETIZED PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). Phys. Lett.; 47A: No. 3, 257-258(25 Mar 1974).

Criteria are presented for the parametric instability in which a pump wave with electric field normal to the external magnetic field excites an upper hybrid mode and a diffusion mode in a magnetized plasma. (auth)

2962 STABILITY OF A LOW PRESSURE PLASMA. Agarwal, D. C. (Univ. of Allahabad, India). Indian J. Theor. Phys.; 21: No. 3, 79-88(Sep 1973).

A study was made of a plasma the pressure of which is small compared with that of the magnetic field. The problem of the equilibrium and the stability of such a plasma is also considered. (auth)

2963 THRESHOLD FIELDS OF THE PURELY GROWING PARAMETRIC INSTABILITIES IN BOUNDED HOMOGENEOUS MAGNETOACTIVE PLASMAS. Zhelyazkov, I.; Nenovski, P. (Sofia Univ., Bulgaria). Plasma Phys.; 16: No. 4, 333-339 (Apr 1974).

A method based on energy balance was applied to derive the threshold fields for the excitation of purely growing surface instabilities in semi-infinite warm magnetoactive plasmas. It was shown that the threshold fields were determined by the same formulas as for the excitation of purely growing parametric volume instabilities in infinite plasma, but the influence of geometry was taken into account by the characteristic frequency of the system. (auth)

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Refer also to abstracts 2639 and 3827.

2964 (CEN/CTR/TM-9) ANALYSIS OF TRITIUM DISTRIBUTION AND LEAKAGE CHARACTERISTICS FOR TWO FUSION REACTOR REFERENCE DESIGNS. Maroni, V. A. (Argonne National Lab., Ill. (USA)). 13 Mar 1974. 45p. Dep. NTIS $5.25.

Results of analyses of the tritium distribution and leakage characteristics for two current fusion power reactor designs — the Princeton Reference Model Tokamak and the LASL/ANL Reference Theta Pinch Reactor — are presented and compared. The philosophy of the model used in these analyses is discussed, and the computer code, developed to carry out the calculations, is described. Consideration is given to the practical aspects of those design features which have the greatest influence on tritium inventories and leakage rates, i.e., (1) the blanket and fuel processing systems, (2) the protective atmospheres, and (3) the application of some special materials as tritium barriers. The results of these analyses have permitted several interesting comparisons to be made between a molten salt/stainless steel reactor design (the Princeton Tokamak model) and a liquid lithium/refractory metal reactor design (the LASL/ANL theta-pinch model). (auth)

2965 (CONF-740402-10) TOKAMAK NEUTRAL BEAM HEATING TECHNOLOGY. Stewart, L. D.; Jernigan, T. C.; Morgan, O. B.; Stirling, W. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 17p. Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Initial design considerations for a 20 A, 150 kV D^0 neutral injection system, based on neutralization of positive ions, are presented. This design has been and will be based heavily on the technology, design experience and operating experience of the successful ORMAK injection systems. Some results of optimizations and parameter studies of the neutralizing cell lengths, neutral fractions, gas flow rates, total beam line lengths, divergence losses, extraction system power loading and power supply current drains are presented. Substantial extraction system power loadings and the resultant power supply current drains indicate a potential problem area. This potential problem area is being approached through experimental tests of system power handling capabilities and tests of the basic concepts underlying the predictions. Approaches in the near future will include tests of multistage extraction systems and tests of various electrode materials and coatings to control secondary emission. Plans are being laid for test stands and power supplies capable of full scale testing of the 150 keV D^0 injection system which evolves. (auth)

2966 (CONF-740402-11) TRITIUM CONTAINMENT AND RECOVERY IN FUSION REACTOR SYSTEMS. Watson, J. S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 17p. Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A review is given of work done at ORNL to meet the needs of the CTR effort. Permeation studies with pure metals and with metals coated with oxides are discussed. An experimental effort to evaluate molten fluoride mixtures for use as blanket materials in fusion reactors is described. (MOW)

2967 (IPPJ-158) CONTROL OF PLASMA CURRENT DISTRIBUTION BY RELATIVISTIC ELECTRON COMPONENTS. Ikuta, K.; Mohri, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 18p. NTIS (US Sales Only).

A possible method of controlling plasma current distribution in the diffuse pinch configuration is proposed. The equilibrium configuration is self-consistently constructed from a combination effect between the plasma force-free current and the relativistic

beam one. The parameters are found, which give an absolute minimum-B configuration. (auth)

2968 (JAERI-M-5298) MAGNETIC FIELD COMPONENTS OF THE PULSED VERTICAL FIELD IN THE JFT-2 DEVICE IN RESONANCE WITH THE ROTATIONAL TRANSFORM OF PLASMA. Matsuda, S. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 11p. NTIS (US Sales Only).

Magnetic field components of the pulsed vertical field in the JFT-2 Tokamak device in resonance with the rotational transform of magnetic lines of force are obtained. Fourier analysis is used to calculate the components on the experimental data obtained with magnetic probes. The size of the islands of magnetic surfaces due to the resonance is discussed in relation to the current distributions. (auth)

2969 (JAERI-M-5369) VACUUM CONDITIONS IN JFT-2. Fujisawa, N.; Sugawara, T.; Toi, K.; Matoba, T.; Kasai, S. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 16p. NTIS (US Sales Only).

The efficiency of discharge cleaning in the tokamak-type apparatus was studied. The duration of repeated discharges is longer than the pumping-out time; the discharges of large current are more effective in removing impurities from the surfaces. The discharges in hydrogen gas produce hydrocarbons. Evacuation characteristics of a turbomolecular pump, a bulk getter pump, and a sputter ion pump are comparatively investigated. (auth)

2970 (JAERI-M-5385) FIRST REPORT ON THE JAERI TOKAMAK EXPERIMENTS. Itoh, S.; Fujisawa, N.; Funahashi, A.; Kunieda, S.; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 18p. NTIS (US Sales Only).

The experimental results obtained with the JFT-2 JAERI tokamak are described. The maximum plasma current is 175 kA, the density is 1.4×10^{13} cm^{-3}, the conductivity electron temperature is 780 eV, the ion temperature is 210 eV, and the energy confinement time is 25 msec. The confinement time is in agreement with the scaling law obtained empirically with other tokamaks. (auth)

2971 (LA-UR-74-613) SENSITIVITY OF NEUTRON MULTIGROUP CROSS SECTIONS TO THERMAL BROADENING OF THE FUSION PEAK. Muir, D. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 8p. (CONF-740402-33). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Thermal motion of the ions in a thermonuclear plasma imparts a considerable energy spread to otherwise monoenergetic products of fusion reactions. Although this phenomenon has become a useful tool in plasma diagnostics, the implications for fusion reactor blanket neutronics have not been explored. Previous theoretical studies of the reaction-product energy spectrum are reviewed, and the results are given for the particular case of neutrons from the D–T reaction in a Maxwellian plasma. Various approximations to the spectrum are examined numerically. Using a simple Gaussian formula, spectrum-averaged cross sections are calculated for several nuclear reactions over a wide range of plasma temperatures. While some cross sections are found to be relatively insensitive to the plasma temperature, a few cross sections of potential interest increase by several orders of magnitude as the plasma temperature is increased from 10 to 40 keV. (auth)

2972 (ORNL-TM-4565) MEASUREMENT OF THE POLOIDAL FLUX PROFILE IN A TOKAMAK BY UTILIZING NEUTRAL BEAM INJECTION. Rome, J. A.; Eubank, H. P. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 8p. Dep. NTIS $4.00.

Part of a neutral beam which is counterinjected into a tokamak is scraped off by the limiter. The edge of the region of contained ions can be measured by a tangential charge exchange analyzer. Using conservation of canonical angular momentum, the poloidal flux profile can be obtained and from this the poloidal B-field and heating current profiles can be easily calculated. (auth)

2973 (UCRL-75546) TRITIUM IN NUCLEAR FUSION POWER. Hickman, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1974. 13p. (CONF-740609-1). Dep. NTIS $4.00.

From 77th national meeting of the American Institute of Chemical Engineers; Pittsburgh, Pennsylvania, USA (2 Jun 1974).

A brief introduction is given to the role tritium will play in the development of fusion power. The biological and world-wide environmental behavior of tritium is reviewed. The tritium problems encountered in fission power reactors are discussed, and the problems expected in fusion power reactors are outlined. (auth)

2974 (WASH-1299) PLANNING RECOMMENDATIONS OF THE AD HOC EXECUTIVE PANEL ON OPEN MAGNETIC CONFINEMENT SYSTEMS. (Ad Hoc Executive Panel on Open Magnetic Confinement Systems (USA)). 17 Nov 1972. 6p. Dep. NTIS $4.00.

Recommended elements of a national program in open systems are given, as well as the relative priority and emphasis which should be placed on these elements, with the aim of bringing Open Systems confinement physics understanding and achievement to the point where it would provide an acceptable basis for the design, review, and approval of a Scientific Feasibility Experiment in a period of 2 to 3 years. (MOW)

2975 VALVE FOR PULSED ADMISSION OF GAS. Kovrov, P. E.; Dmitruk, M. I. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1512-1513 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 180-181(1973).

A simple valve for pulsed admission of a practically unlimited batched quantity of gas into a vacuum during a time of 100 to 500 μsec is described. A special feature of the valve is the use of a shock wave which develops as a result of an electrical discharge in a liquid that conducts electric current weakly as the source of the pulse. The valve is designed for use in pulsed plasma systems. (auth)

2976 INSTRUMENTATION CURRENT PULSE TRANSFORMER FOR THE NANOSECOND RANGE. Ivanov, B. I.; Miroshnichenko, V. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1457-1460(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 138-140(1973).

A new type of instrument current pulse transformer (i.t.) is considered in which the secondary winding is split into sections consisting of one or several turns. The sections are connected in parallel with a common load whose signal is proportional to the measured current. The requirement of axial symmetry of the measurement current and the i.t. is not mandatory. The resolving time is determined principally by the dimensions of the secondary-winding section and can be made ~1 nsec or less. The construction of the i.t. is described, and results of measurements are presented. (auth)

2977 JOINT EUROPEAN TOKAMAK. Braams, C. M.; van Ingen, A. M.; Brandt, B. Atoomenergie Haar Toepass.; 15: No. 12, 285-289(Dec 1973). (In Dutch).

A summary of exploratory meetings at UKAEA Culham Laboratories, autumn 1973, to discuss European thermonuclear collaboration is given. Suggested parameters for a Joint Tokamak Experiment are tabulated (e.g., toroidal radius 2.7m, plasma radius 1.3m, pulse duration 20 sec, magnetic energy ~250 MJ); and a tentative timescale is proposed, envisaging completion by 1978. (NL)

2978 FUSED-SALT CORROSION AND ITS CONTROL IN FUSION REACTORS. Cantor, S.; Grimes, W. R. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 1, 120-126(Apr 1974).

Through extensive testing in fission-reactor programs, molten Li_2BeF_4 is known to be compatible with graphite and with many useful structural metals. In service as a Controlled Thermonuclear Reactor blanket-coolant fluid, however, corrosion by this molten salt may be enhanced by (a) the effect of magnetically induced electric fields, (b) the consequences of chemical transmutations in the blanket, and (c) inadvertent mixing with other materials through leaks between fluid circuits. Fused salts flowing at high velocity across strong magnetic fields can experience intolerably large induced electromotive forces (emfs); measurements of emfs induced in aqueous solutions with electrical conductivities less than that of Li_2BeF_4 were found to obey Faraday's law of electromagnetic induction even under highly turbulent flow conditions. Induced emfs, of course, are absent when the flow is parallel to the magnetic field lines and should be minimized by such flow conditions wherever possible. In regions where molten salt enters and leaves the blanket structure, induced emfs can be minimized by (a) dividing the flow among many small parallel pipes, (b) using ferromagnetic pipe sections, and (c) perhaps maintaining a frozen layer of salt on internal surfaces of pipe. Transmutations of lithium, beryllium, and fluorine in the blanket yield oxidants capable of corroding structural metals. Such corrosion can presumably be avoided by adding a reductant of suitable redox potential to the blanket. For example, low concentration of dissolved CeF_3 or slurried beryllium should be capable of reacting with the oxidants and minimizing their deleterious effect. (auth)

2979 PRELIMINARY ASSESSMENT OF CORROSION PRODUCT TRANSPORT IN FUSION REACTORS. Johnson, A. B. Jr.

(Battelle Pacific Northwest Lab., Richland, WA); Vogelsang, W. F. Nucl. Technol.; 22: No. 1, 115-119(Apr 1974).

Corrosion which is tolerable from the standpoint of system mechanical integrity may cause substantial problems if the corrosion product is released and deposited at locations where it interferes with heat transfer or coolant flow. Furthermore, neutrons from the fusion reaction activate the corrosion product, causing radiation fields in maintenance areas near piping and components where the activated material is deposited. Preliminary estimates suggest that formidable problems may occur in a lithium-cooled stainless-steel primary circuit due to corrosion product deposition. If the estimated order of magnitude is confirmed in future studies, new concepts in corrosion control or corrosion product removal would need to be developed for lithium-cooled stainless-steel Controlled Thermonuclear Reactor (CTR) systems. Other fusion reactor system concepts and materials appear to offer alternatives which tend to minimize corrosion product transport. (auth)

2980 EFFECTIVENESS OF TRITIUM REMOVAL FROM A CTR LITHIUM BLANKET BY COLD TRAPPING SECONDARY LIQUID METALS Na, K, AND NaK. Natesan, K.; Smith, D. L. (Argonne National Lab., IL). Nucl. Technol.; 22: No. 1, 138-150(Apr 1974).

Thermodynamic calculations were made on the distribution of hydrogen and tritium between various refractory metals and liquid lithium as a function of temperature. The limiting tritium pressures that can be attained by cold trapping secondary liquid metals such as sodium, potassium, and sodium–78 wt % potassium (NaK) were also calculated. In the absence of tritium breeding, these pressures are 2.5×10^{-6}, 2×10^{-7}, and 1.2×10^{-10} Torr for sodium, potassium, and NaK, respectively, which correspond to tritium concentrations in lithium of 45, 4, and < 1 ppm, respectively, at 700°C. For a 1000-MW(th) thermonuclear reactor with a tritium breeding rate of 150 g/day, a tritium recovery system that incorporates (a) a separate lithium purification loop with niobium as the permeable membrane, (b) NaK as the secondary heat transport fluid, and (c) tungsten cladding on the IHX tubes will yield a tritium pressure of 10^{-9} Torr or less in the secondary system. This configuration will result in a tritium release rate $\sim 10^{-6}$ g/h to the steam system for a tungsten-clad steam generator operating at ~600°C. The corresponding activity release rate is ~300 Ci/yr. (auth)

2981 RELEVANCE OF VARIOUS NEUTRON SOURCES TO FUSION-REACTOR RADIATION EFFECTS. Logan, C. M. (Univ. of California, Livermore); Anderson, J. D.; Munir, Z. A. Nucl. Technol.; 22: No. 1, 36-44(Apr 1974).

Primary-recoil spectra, damage-energy spectra, and rates for (n,2n), (n,p), and (n,α) reactions were calculated for niobium exposed to several neutron environments. Neutrons from the ^{9}Be(d,n) reaction introduce defects with qualitative similarities to those produced by a D–T fusion reactor. Low-energy neutrons such as those present in the core of EBR-II induce neither high-energy primary recoils nor significant transmutations. (auth)

2982 MATERIALS PROBLEMS IN THE DESIGN OF MAGNETICALLY CONFINED PLASMA FUSION REACTORS. Fraas, A. P. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 1, 10-19(Apr 1974).

Conceptual design studies disclose that when the plasma physics problems of fusion reactors are sufficiently in hand to permit the design and construction of a fusion power plant, the designer will be confronted with many materials problems that are the same as or similar to those of fission reactors, e.g., radiation damage, the compatibility of liquid metals with structural materials, and hydrogen permeation and embrittlement. In addition, there will be new problems such as sputtering and other radiation damage by ion bombardment and the special problems of superconducting materials and operation of highly stressed magnet coil structure at temperatures near 4°K. (auth)

2983 RADIATION DAMAGE LIMITATIONS IN THE DESIGN OF THE WISCONSIN TOKAMAK FUSION REACTOR. Kulcinski, G. L.; Brown, R. G.; Lott, R. G.; Sanger, P. A. (Univ. of Wisconsin, Madison). Nucl. Technol.; 22: No. 1, 20-35(Apr 1974).

A detailed analysis of the radiation damage problems to be expected in a specific D–T fueled fusion reactor has been conducted. The system examined is the 5000-MW(th) University of Wisconsin Tokamak reactor (UWMAK), which is constructed of 20% cold-worked Type-316 stainless steel and operated at a maximum temperature of 500°C and a neutron wall loading of 1.25 MW/m^2. The major radiation damage problem appears to be the loss in ductility; that is, the uniform elongation of the Type-316 stainless steel in the UWMAK-I first wall may fall to <0.5% after one to two years of operation. Another serious problem will be the void-induced swelling in the steel. Based on current design equations, the swelling in the steel of the first wall will exceed the design limit of 10% in approximately five years of operation. The wall erosion rate due to neutron and charged-particle sputtering, coupled with exfoliation due to blistering, is calculated to be 0.22 mm/yr. Finally, calculations reveal that the radiation damage problems in the superconducting magnets can be incorporated into the design without difficulty. The integral wall-loading limits for embrittlement, swelling, wall erosion, and magnet damage in UWMAK are calculated to be 2, 6, 25, and 100 MW yr/m^2, respectively. (auth)

2984 TECHNOLOGICAL DEVELOPMENTS TOWARD A FUSION REACTOR. Abstract. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

A discussion is given of technological problems in D-T fusion reactors as, for example, neutron physics as involved in transfer of kinetic energy to the walls and thermal conversion processes in an external loop. Further problems arise for liquid metal cooling, radioactivation of structural materials, and tritium release. (GE)

2985 PLASMA-WALL INTERACTIONS: A PROBLEM OF SURFACE PHYSICS. Abstract. Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp. (In German).

From information meeting of the Max-Planck-Institut fuer Plasmaphysik; Garching, Germany (7 Nov 1972).

As impurities will cause radiation losses in a hydrogen plasma, great emphasis must be placed on the purity of the plasma. This requires not only pure starting conditions, and thus ultrahigh vacuum techniques, but also a good knowledge of the processes which lead to the emission of material at the walls due to the action of the plasma. Finally, the interaction between plasma and wall will influence the energy and particle balance in the plasma so that a thorough knowledge of the processes at the wall is one of the conditions of a full understanding of the plasma properties. Among the great number of processes responsible for the emission of "particles" from the plasma at the wall—as, e.g., electrons, ions, neutral atoms, photons and, in the case of a fusion plasma, neutrons—the interaction of ions with solid particles is currently of particular interest. Experiments are carried out to investigate the energy, angle and charge distribution of the backscattered primary particles, the influence of ion bombardment on the surface structure and the sputtering of the solid body. The sputtering process is also important with respect to fusion reactors as it is assumed that sputtering causes migration erosion in fusion reactors. The investigation of these surface processes requires high-standard and efficient measuring techniques, and part of the work of the IPP is mainly concerned with the steady development of such techniques and apparatus. (GE)

Wave Phenomena

2986 (AD-769235) FLUID THEORY OF REFLECTED PARTICLES IN ION ACOUSTIC SHOCKS. Manheimer, W. M.; Harber, I. (Naval Research Lab., Washington, D. C. (USA)). Sep 1973. 65p. (NRL-MR-2656). NTIS $3.00.

The time-independent equation of motion for a one-dimensional ion fluid of velocity v and temperature T in an electric field E is presented. This equation has a singularity at 3T. This singularity is of crucial importance in any shock whose downstream state satisfies 3T > M (v squared). Assuming a square (waterbag) ion distribution function, the singularity occurs where the first ion is reflected. By adding the presence of a second (reflected) fluid, it is possible to join these two fluids to form a single fluid beyond the singularity. Using this technique the structure of ion acoustic shocks containing reflected particles, and the solutions are identical with direct solutions of the Vlasov equation. The advantage of the fluid formulation is that one can investigate the effect of anomalous friction and energy exchange between incident and reflected beams. (auth)

2987 (IPPJ-150) THEORETICAL ANALYSIS OF ION CYCLOTRON WAVES. Matsuura, K.; Toyama, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1973. 53p. NTIS (US Sales Only).

Dispersion and energy relations of ion cyclotron waves in a cold plasma are systematically studied retaining the electron mass. In this case, two wave modes having different perpendicular wave numbers can exist in a uniform plasma column. The dominant mode is a quasi-TE mode, in which the plasma cur-

rent j_z is an important quantity. Because this current is carried by electron motion along the static magnetic field, the dispersion relation and energy relations are considerably modified for light mass ions compared with the customary one in which the electron mass is neglected. Plasma loading for a coil excitation of the Stix type is also considered using this dispersion relation. The electric field, magnetic field, energy density, and energy flow are calculated based on the quasi-TE mode. The energy losses due to cyclotron damping and collisions are also summarized. Here a possible mechanism due to resistivity is pointed out. (auth)

2988 (IPPJ-154) ANOMALOUS PENETRATION OF AN ORDINARY WAVE INTO A MAGNETOPLASMA SLAB. Ishida, A.; Kitao, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1973. 24p. NTIS (US Sales Only).

The penetration of an ordinary wave into an infinite magnetoplasma slab is calculated by adopting the image-metal technique in treating the electrons reflected at the plasma boundaries. After general expressions are derived, the wave frequency is assumed to be near the electron cyclotron frequency because the influence of the thermal motion of electrons is remarkable only for this case. It is found that the evanescent wave penetrates deeply into the slab compared with the case of a cold plasma, and the size effect appears due to the increase of the wave reflection at the plasma-vacuum boundary. The absorptive power due to collisions, evaluated for the limiting case of infinite thickness of the slab, is much larger than the value for a cold plasma and shows the surface effect. These two effects become more noticeable for the higher density and higher temperature of the plasma. (auth)

2989 (IPPJ-155) NONLINEAR ION ACOUSTIC WAVES WITH LANDAU DAMPING. Van Dam, J. W.; Taniuti, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 32p. NTIS (US Sales Only).

The Korteweg-deVries equation for the ion acoustic wave, modified to include the effects of ion and electron linear Landau damping, is rigorously derived from the Vlasov-Poisson equations by a multi-scale asymptotic expansion method. Careful examination of the various orderings also shows that nonlinear resonance effects (trapping, reflection) can be significant. (auth)

2990 (IPPJ-156) LAMINAR ELECTROSTATIC SHOCK WAVES GENERATED BY AN ION-BEAM. Ikezi, H.; Kamimura, T.; Kako, M.; Lonngren, K. E. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 26p. NTIS (US Sales Only).

Strong laminar electrostatic shock waves have been experimentally observed when an ion-beam is injected into a collisionless plasma. The structure of the shock is qualitatively different from one with a trailing wave train. A density depression follows behind the shock front, and no trailing wave train due to wave dispersion is found. A significant amount of ions reflected from and transmitted through the shock front form a precursor. The critical Mach number above which no shock is formed is found to be 1.5. Numerical simulations reported here reproduce the experimental observations very well. An analysis based on the water-bag model accounts for the observed value of the critical ion-beam velocity which gives the critical Mach number. It also points out that the reflected ions play an essential role in the persistence of the shock. (auth)

2991 (IPPJ-157) ACCESSIBILITY OF ION-ION HYBRID RESONANCE. Toyama, H.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 12p. NTIS (US Sales Only).

The dispersion relation for the ion-ion hybrid resonance was investigated in the density region of 10^6 cm^{-3} to 10^{17} cm^{-3} with the parallel wave number as the parameter, and the accessibility condition is presented. (auth)

2992 (JINR-E9-7717) DYNAMICS OF LANGMUIR TURBULENCE. Formation and Interaction of Solitons. Abdulloev, Kh. O.; Bogolubskii, I. L.; Makhankov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 11p. Dep. NTIS (U. S. Sales Only) $4.00.

The nonlinear stage of the so-called quasidecay instability of Langmuir turbulence spectra was investigated using a computer. The principal role of ion acoustic waves is shown for the processes of formation and interaction of solitons. This leads to an opportunity of coupling of solitons. (auth)

2993 (N-73-30694) THEORY FOR SCATTERING BY DENSITY FLUCTUATIONS BASED ON THREE-WAVE INTERACTION. Harker, K. J.; Crawford, F. W. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1973. 38p. NTIS $4.00.

The theory of scattering by charged particle fluctuations of a plasma is developed for the case of zero magnetic field. The source current is derived on the basis of: (1) a three wave interaction between the incident and scattered electromagnetic waves and one electrostatic plasma wave (either Langmuir or ion acoustic), and (2) a synchronous interaction between the same two electromagnetic waves and the discrete components of the charged particle fluctuations. Previous work is generalized by no longer making the assumption that the frequency of the electromagnetic waves is large compared to the plasma frequency. The general result is then applied to incoherent scatter, and to scatter by strongly driven plasma waves. An expansion is carried out for each of those cases to determine the lower order corrections to the usual high frequency scattering formulas. (auth)

2994 (RISO-299) CALCULATIONS OF PROPAGATION OF DENSITY PERTURBATIONS IN COLLISIONLESS PLASMAS. Joergensen, L. W.; Pecseli, H. L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1973. 41p. Dep. NTIS (US Sales Only) $5.25.

Exact analytical solutions were obtained to the linearized, two-species Maxwell-Vlasov equations for the evolution of an initial density perturbation in an initially stable, neutral plasma. Two initial perturbations are considered: a step-like and a pulse-like discontinuity. (auth)

2995 ELECTROSTATIC WAVE REFLECTION FROM A PLASMA DENSITY GRADIENT. Roberson, C.W.; Ratner, A.S.; Hirshfield, J.L. (Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 31: No. 17, 1041-1044 (22 Oct 1973).

We report measurements of the reflection coefficient R for electron plasma waves propagating into a density gradient on a narrow column. Within experimental error, R is proportional to $\exp(-\delta)$ when R is less than 0.25 and is equal to $\exp(-0.23\delta)$ for R greater than 0.25, where δ is the inverse of the WKB parameter. (auth)

2996 VAN DER POL MODEL FOR UNSTABLE WAVES ON A BEAM-PLASMA SYSTEM. DeNeef, P. (Physics Department, University of California at San Diego, La Jolla, California 92037); Lashinsky, H. Phys. Rev. Lett. 31: No. 17, 1039-1041 (22 Oct 1973).

The unstable modes on a low-density, cold-electron-beam-plasma system are treated as an ensemble of Van der Pol oscillators. This model predicts the observed amplitude limiting of unstable waves at the neighboring frequencies of a launched wave that traps the beam electrons. (auth)

2997 CONTROLLED EXCITATION OF ION ACOUSTIC WAVES BY ION SHEET BEAMS. Ohnuma, T.; Fujita, T.; Adachi, S. (Department of Electrical Engineering, Tohoku University, Sendai, Japan). Phys. Rev. Lett. 31: No. 19, 1177-1180 (5 Nov 1973).

When ion sheet beams modulated at a prescribed frequency are injected into plasmas, ion acoustic waves are found to be excited nearly perpendicularly to the ion sheet beams. The amplitude and frequency of the ion acoustic waves can be controlled by changing the modulation amplitude and frequency of the ion beams. The exciting mechanism is qualitatively explained by a fluid model. (auth)

2998 OPTICAL PROPERTIES OF A PLASMA SPHERE. Ruppin, R. (Soreq Nuclear Research Centre, Yavne, Israel). Phys. Rev. Lett. 31: No. 24, 1434-1437 (10 Dec 1973).

The classical theory for the scattering and absorption of electromagnetic radiation by a homogeneous isotropic sphere is extended so as to apply to a sphere in which dispersive plasma oscillations exist. Computations performed for small metallic spheres predict the appearance of an absorption structure in the frequency region just above the plasma frequency. (auth)

2999 SPECTRA OF STRONG LANGMUIR TURBULENCE. Kingsep, A.S.; Rudakov, L.I.; Sudan, R.N. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. Lett. 31: No. 25, 1482-1484 (17 Dec 1973).

Strong Langmuir turbulence is described in terms of a random set of blobs of self-trapped plasma waves. The interaction of these blobs leads to the generation of power spectra $\langle |E_k|^2 \rangle \propto k^{-2}$ that agree with the results of one-dimensional computer simulation. (auth)

3000 DRIFT WAVES IN TURBULENT PLASMAS. Satya, Y.S.; Kaw, P.K. (Physical Research Laboratory, Ahmedabad, India). Phys. Rev. Lett. 31: No. 24, 1453-1456 (10 Dec 1973).

The influence of a turbulent spectrum of high-frequency, short-wavelength electron plasma waves on the linear dispersion relation for low-frequency, long-wavelength drift waves has been analytically investigated. (auth)

3001 STIMULATED BRILLOUIN EFFECT IN WEAKLY IONIZED PLASMA. Aubrecht, L. (Technical Univ., Prague). Czech. J. Phys.; 24: No. 4, 413-422(1974).

The stimulated Brillouin effect in gaseous plasma was investigated by means of classical coupled-mode analysis. This process is described as interaction between an ion-acoustic plasma wave and two light waves. The threshold power levels calculated are achievable in giant-pulse lasers. However, the Brillouin effect may possibly be observable in the dense plasma or in the far infrared region of the electromagnetic spectrum. (auth)

3002 PHASE-UNCERTAINTIES OF INDIVIDUAL MODES IN NONLINEAR SYSTEMS. Wilhelmsson, H. (Chalmers Tekniska Holgskola, Goteborg). Phys. Scr.; 9: No. 1, 61-66(Jan 1974).

The evolution and partition of initially small phase-uncertainties (or perturbations) of individual modes in nonlinear systems of waves were studied. The characteristic times are estimated for the transfer of phase-uncertainties between the different interacting modes as well as for the growth (or dissipation) of phase-uncertainties of each mode in stable and nonlinearly unstable situations. (auth)

3003 COMPUTATION OF ION-ACOUSTIC WAVE EXCITATION AND ITS ANOMALOUS EFFECTS FOR DOUBLE-SIDED LASER–PLASMA INTERACTION. Wilhelmsson, H. (Chalmers Techniska Hoegskola, Goteborg); Oestberg, K.; Stenflo, L.; Tsytovich, V. N. Phys. Scr.; 9: No. 2, 119-120(Feb 1974).

Computer results based on a self-consistent nonlinear analysis are given for the (one-dimensional) problem of laser interaction with a plasma layer. Effects of ion-acoustic wave excitation are studied assuming that the plasma is exposed to incident radiation from two oppositely directed laser beams. (auth)

3004 LAGRANGIAN AND HAMILTONIAN FORMULATIONS FOR MAGNETO-FLUID-DYNAMIC WAVES. Mattei, G. Boll. Unione Mat. Ital.; 7: 302-308(Apr 1973).

A derivation is given of the three-dimensional wave equation for a nondissipative plasma described by the linearized magneto-fluid-dynamic (MFD) equations. After reviewing the linearized MFD equations for an ideal (i.e., nondissipative) plasma and the corresponding three-dimensional wave equations, as well as the foundations of the Lagrangian and Hamiltonian formulations for continuous systems, the linearized three-dimensional MFD wave equations are derived from a Lagrangian and from a Hamiltonian formulation for a compressible barotropic plasma and an incompressible plasma. (IAA)

3005 TRANSVERSE ECHO OSCILLATIONS IN A MAGNETOACTIVE PLASMA. Pavlenko, V. V. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Ukr. Ed.); 18: 1769-1776(Nov 1973). (In Ukrainian).

Theoretical analysis of transverse plasma echo oscillations arising at the cyclotron frequency due to the superposition of Langmuir and cyclotron waves in an electron plasma subject to an external magnetic field. An expression is derived for the electric field of a left-hand circularly polarized cyclotron echo signal produced by the superposition of a weakly damped, left-hand circularly polarized cyclotron oscillation on a Langmuir oscillation. It is shown that the dispersion and polarization of the arising echo oscillations are dependent not only on the dispersion properties of the plasma but also on the sequence in which the disturbances are applied to the plasma. Thus, the superposition of Langmuir waves on left-hand circularly polarized cyclotron oscillations will produce right-hand circularly polarized cyclotron echo signals. (IAA)

3006 MONOPOLE AND DIPOLE ANTENNAS IN A NONLINEAR ISOTROPIC PLASMA. Bantin, C. C.; Balmain, K. G. (Univ. of Toronto). Can. J. Phys.; 52: No. 4, 302-317(15 Feb 1974).

The theoretical nonlinear response of a plasma is studied for the case of two rf signals simultaneously applied to the terminals of thin-wire monopole and dipole antennas of arbitrary length. Distributed nonlinear sources of charge density and current density are identified and used to calculate induced open-circuit antenna terminal voltages at harmonic, sum, difference, and intermodulation frequencies and at dc (rectification). The importance of the antenna as a field scatterer is identified for the calculation of radiation fields and higher-order near fields. Experiments on the terminal properties of a monopole antenna were performed in a laboratory gas discharge and quantitative agreement with cold-plasma theory is demonstrated for frequencies above about half the plasma frequency; lower frequency response closely resembles earlier predictions using warm-plasma theory. Experiments and theory for a constant rf input current indicate that the plasma frequency can be identified and therefore that the antenna system is useful for electron-density diagnostics. Experiments indicate a complex form of signal limiting or saturation, but below this level there exist situations where the nonlinear response is high enough to be classified as interference in practical systems. (auth)

3007 EXPERIMENTAL OBSERVATION OF NONLINEAR ION–ACOUSTIC RESONANCES IN BOUNDED PLASMA. Nikolov, N. (Univ., Sofia). Phys. Lett.; 47A: No. 3, 255-256 (25 Mar 1974).

Experiments for the determination of the resonances were performed using the plasma of the positive column of plane discharge tubes. The plane condenser was 2.5 to 3.5 cm thick, and 6 to 9 cm long. The measurement was made in neon at pressure of 10^{-2} to 10^{-1} torr. By means of a double probe method the plasma parameters (electron temperature T_e and density n_e) were measured. (MOW)

3008 HIGH-MACH NUMBER ELECTROSTATIC SHOCKS IN COLLISIONLESS PLASMAS. Singh, N. (Indian Inst. of Tech., Kanpur). Indian J. Pure Appl. Phys.; 11: No. 7, 533-534(Jul 1973).

Using the adiabatic relation $p^{\gamma} =$ constant for the electrons, a simple calculation is given to predict the parameters of an ion acoustic solitary wave. It is found that the critical Mach number is 4.4, which is much higher than the critical Mach number 1.6 predicted by the isothermal law for the electrons. But the value 4.4 is in accord with the results obtained by earlier numerical computations. (auth)

3009 DISPERSION RELATION IN MAGNETO-PLASMA WITH RADIATION DAMPING AND COLLISIONS. Konar, A. N. (Jaipuria Coll., Calcutta). Acta Phys. Acad. Sci. Hung.; 34: No. 4, 299-303(1973).

A study was made of the dispersion relation in the case of propagation of small-amplitude longitudinal as well as transverse waves in plasma in the presence of an external uniform magnetic field. The statistical approach was adopted for studying the plasma. The effects of radiation damping and self-collisions on the propagation of the electromagnetic waves were considered and compared with those cases where no such effects are present. (auth)

3010 DRIFT WAVE ANOMALOUS TRANSPORT IN AXISYMMETRIC TOROIDAL PLASMAS. Dobrowolny, N.; Nocentini, A. (CNEN, Frascati, Italy). Plasma Phys.; 16: No. 5, 433-445(May 1974).

A quasi-linear theory of the anomalous transport properties of an axisymmetric toroidal plasma caused by unstable drift waves was developed. Both particle and kinetic energy fluxes across magnetic surfaces were derived and discussed. Applications of the results were made to several drift instabilities which are likely to be present in actual toroidal devices. Estimates and comparisons for such devices showed that the derived anomalous fluxes were likely to be higher than classical values even for small fluctuation levels. (auth)

3011 ENERGY CONVECTING ION SOUND MODES IN PLASMA SKIN LAYER. Santini, F. (CNEN, Frascati, Italy). Plasma Phys.; 16: No. 5, 449-453(May 1974).

The stability analysis of plasma eigenmodes of the ion acoustic type was carried out by using a plane slab model with sheared magnetic field. Their growth rate was reduced by the shear which makes possible solutions of the convective type across the magnetic field. The energy convection was estimated and compared with other transport processes. This energy loss was proposed as a possible mechanism for the observed anomalous skin effect in tokamak discharges. (auth)

3012 COMPLETE ELECTROSTATIC SPECTRUM OF MAGNETOPLASMA SLABS. de Santis, P. (Univ., Naples). Alta Freq.; 42: 557-559(Oct 1973).

The calculation results for the complete electrostatic spectrum of an infinite slab of plasma magnetized in its plane are presented. A lossless dielectric characterization of the plasma is adopted. The spectrum is studied for propagation at any angle to the dc magnetic field. (IAA)

3013 PROPAGATION VELOCITY OF WHISTLER-MODE SIGNALS IN AN UNSTABLE AND ABNORMALLY DISPERSIVE PLASMA–BEAM SYSTEM. Matsumoto, H.; Kimura, I. (Kyoto Univ.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-22: No. 1, 136-140(Jan 1974).

A propagation velocity of a whistler-mode signal in an unstable and abnormally dispersive plasma–beam system was investigated. Responses of the plasma in real time and space were computed by the inverse Fourier–Laplace transformation. The computed results of the propagation velocity are compared with various velocities analytically determined from the dispersion equation. (auth)

3014 DAMPING OF PLASMA COLUMN RESONANCES BY ELECTRON DENSITY FLUCTUATIONS. Kanwal, J.; Gregory, B. C. (Univ. of Quebec, Varennes). Can. J. Phys.; 51: No. 24, 2499-2504(15 Dec 1973).

Random fluctuations of the electron density can considerably influence the shape of the resonance curve exhibited by a plasma column. The fluctuations affect the resonances in a different way, depending on the order of the resonance considered. For the main resonance both the amplitude and the half-width change appreciably; however, the resonance amplitude is more sensitive to low level density fluctuations than the half-width. The first Tonks–Dattner resonance half-width remains practically constant, but the resonance amplitude decreases with increase in the level of density fluctuations. The main resonance interaction with the density fluctuations is also computed theoretically for a plasma column inserted in a waveguide, excited in the TE_{10} mode, assuming that the plasma behaves as a dielectric medium. The results are in good agreement with the experiment. (auth)

3015 OBSERVATION OF QUASI-COHERENT ELECTRON OSCILLATIONS AND SPATIAL BUNCHING IN A CONVERGING BEAM–PLASMA SYSTEM. Schott, L.; Silawatshananai, C. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 51: No. 23, 2448-2454(1 Dec 1973).

A spatially periodic modulation of the plasma density is observed which is attributed to nonlinear bunching of counterstreaming electron beams leading to locally enhanced ionization. Microwave bursts (~1 to 5 GHz) strongly polarized in the direction of the beams are detected. Nearly coherent oscillations are found at frequencies about one order of magnitude lower than the electron plasma frequency but above the ion plasma frequency. The oscillations can be described by a theoretical cold beam–cold plasma model which takes into account the finite size of the plasma. The experimental results are in qualitative agreement with this model. A negative voltage pulse of 500 V and ~10 μs duration is applied between two concentric cylindrical electrodes. The outer electrode, the cathode, consists of heated tungsten filaments; the inner one, the anode, is perforated. The electrons emitted by the filaments are accelerated into the space enclosed by the anode where a plasma of a density $N_p \simeq 2\text{–}4 \times 10^{11}$ cm^{-3} and an electron energy of 1.5 to 10 eV is formed in argon at a pressure of 5×10^{-4} torr. (auth)

3016 CONSTITUTIVE RELATIONS AND SUBSIDIARY CONDITIONS IN THE EIKONAL APPROXIMATION. Gelman, H. (MITRE Corp., Bedford, MA). Can. J. Phys.; 51: No. 24, 2587-2603(15 Dec 1973).

The eikonal approximation is considered for propagation in an inhomogeneous, time-dependent, anisotropic environment. The usual eikonal analysis is generalized to take into account constitutive relations which contain space and time derivatives of the field quantities. The field equations are obtained for all orders of eikonal approximation. These consist of homogeneous equations for the zeroth-order, and recursion relations which connect arbitrary consecutive higher orders of approximation. An apparent inconsistency between the zeroth-order equations and the higher order ones is avoided by the development of a set of subsidiary conditions on the field approximations. The lowest order condition in this set is considered in detail, and a general relation is derived between a certain vector quantity appearing in this condition, and the tangent vector to a ray path. For an environment which is stationary and free of spatial dispersion, this relation is shown to have, as one of its consequences, a new normalization condition for the zeroth-order fields in anisotropic propagation. The relation is applied to propagation in a cold magnetoplasma, and a number of results in ionospheric propagation are recovered and extended. (auth)

3017 POSSIBILITY TO GENERATE POWERFUL BURSTS OF MICROWAVES BY THE INTERACTION OF AN INTENSE RELATIVISTIC ELECTRON BEAM WITH A MAGNETIZED PLASMA. Winterberg, F. (Univ. of Nevada, Reno). Atomkernenergie; 22: No. 3, 205-207(Dec 1973).

A method is described which permits the generation of very powerful bursts of microwaves by the interaction of an intense relativistic electron beam with a magnetized plasma. The microwaves are excited and emitted near the upper hybrid resonance by the collective two-stream, beam–plasma instability. The possible wavelengths can cover a wide spectrum by changing the plasma density. The electron beam is generated by the field emission process. The energy for the electron beam can be for example, drawn from a Marx Blumlein line high-voltage generator or a Van de Graaff generator. Because electron beams of very high intensity can be produced in this way, the method seems to promise the generation of very powerful bursts of microwaves which are otherwise unattainable. The method can be applied to operate a radar device of extremely high peak power and short wavelength. (GE)

3018 NUMERICAL ANALYSIS OF THE DISPERSION EQUATION OF THE BEAM–PLASMA INTERACTION IN A RELATIVELY WEAK MAGNETIC FIELD. Takahashi, S. (Yamanashi, Univ., Kofu, Japan). Yamanashi Daigaku Kyoikugakubu Kenkyu Hokoku; No. 21, 174-177(Mar 1971).

Beam–plasma interaction in a cylindrical plasma is treated through its dispersion equation containing boundary conditions for the radial coordinate, especially for phenomena relating to waves propagating perpendicularly to the symmetric axis. One aspect of the waves in such a system is generally much different from one in a one-dimensional system. However, some types of waves excited in the system can be explained rather good. The one dimensional dispersion equation is numerically analyzed, and growth rates of the waves are calculated. (JA)

ENGINEERING

Energy Conversion

Refer also to abstracts 2714 and 5507.

3019 (JPRS-61609) RESEARCH ON MATERIALS FOR THE MANUFACTURE OF OPEN-CYCLE MHD GENERATOR ELECTRODES. Samsonov, G. V.; Sleptsov, V. M.; Gnesin, G. G.; Fomenko, V. S.; Podchernyaeva, I. A.; Lapshov, Yu. K.; Shegolev, G. M.; Kukota, Yu. P.; Strashinin, E. P. 29 Mar 1974. Translated from pp 393-409 of Issledovanie Materialov Dlya MGDG Otkrytogo Tsikla, Kiev, 1971. 14p. NTIS.

Results of tests of porous electrodes in a model MHD generator and data on the properties of nonporous silicon carbide are presented. (TFD)

3020 (N-73-25723) ELECTRODES FOR THE THERMIONIC CONVERTERS, PHASE 2-3. Final Report. DeSteese, J. G. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Dec 1972. Contract NAS7-100. 51p. (NASA-CR-131838; MDC-G-4401). NTIS $4.75.

For Jet Propulsion Lab., Pasadena, CA.

The characteristics of electrodes for thermionic converters are discussed. A metal/ceramic Marchuk tube was constructed and operated with a quiescent cesium vapor plasma corresponding to cesium liquid reservoir temperatures from 376 to 427°K. The work function characteristics of tantalum test emitters coated with anodic films were measured to evaluate the applicability of the materials as the collector surface in a plasma mode thermionic converter. Work function minimum values between 1.4 and 1.5 electron volts were observed. The effect of the electronegative surface layers was partially obscured by additive vapor impurities detected by the clean tantalum reference emitter. (auth)

3021 (N-73-25724) FEASIBILITY STUDY OF OXYGEN-DISPENSING EMITTERS FOR THERMIONIC CONVERTERS, PHASE 1. Final Report. DeSteese, J. G. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). May 1972. Contract NAS7-100. 51p. (NASA-CR-131837; MDC-G-3144). NTIS $4.75.

For Jet Propulsion Lab., Pasadena, CA.

A metal/ceramic Marchuk tube was used to measure work functions of oxygen-doped tantalum, to determine applicability of the material to plasma-mode thermionic converters. Oxygen-doped tantalum was shown to increase in work function monotonically with oxygen doping in the range 0.1 to 0.3 at. %. Oxygenated test emitters were run at an average temperature of 2165°K and a T/T_{Cs} ratio - 5.8 to observe the influence of oxygen depletion. Bare work function decreased with outgassing of oxygen. Projections were made based on outgassing kinetics and area/volume ratios to calculate the longevity of oxygen doping in a practical converter. Calculations indicated that the program goal of 10,000 h could be achieved at 1800°K with an initial oxygen doping of 1 at. % and a practical emitter area/volume ratio. (auth)

3022 (N-74-13466) LIQUID METAL MAGNETOHYDRODYNAMICS (LMMHD) TECHNOLOGY TRANSFER FEASIBILITY STUDY. Volume 1. Summary. Phen, R. L.; Hays, L. G.; Alper, M. E. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 18 May 1973. 60p. (NASA-CR-136197; JPL-1200-59(Vol.1)). NTIS $5.00.

The potential application of liquid metal magnetohydrodynamics (LMMHD) to central station utility power generation through the period to 1990 is examined. Included are: (1) a description of LMMHD and a review of its development status, (2) LMMHD preliminary design for application to central station utility power generation, (3) evaluation of LMMHD in comparison with conventional and other advanced power generation systems, and (4) a technology development plan. One of the major conclusions found is that the most economic and technically feasible application of LMMHD is a topping cycle to a steam plant, taking advantage of high temperatures available but not usable by the steam cycle. (auth)

3023 (N-74-13467) LIQUID METAL MAGNETOHYDRODYNAMICS (LMMHD) TECHNOLOGY TRANSFER FEASIBILITY STUDY. Volume 2. Appendixes. Phen, R. L.; Hays, L. G.; Alper, M. E. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 18 May 1973. 198p. (NASA-CR-136198; JPL-1200-59(Vol.2)). NTIS $12.00.

The potential application of liquid metal magnetohydrodynamics (LMMHD) to central station utility power generation through the period to 1990 is examined. Included are: (1) a description of LMMHD and a review of its development status, (2) LMMHD preliminary design for application to central station utility power generation, (3) evaluation of LMMHD in comparison with conventional and other advanced power generation systems, and (4) a technology development plan. One of the major conclusions found is that the most economic and technically feasible application of LMMHD is a topping cycle to a steam plant, taking advantage of high temperatures available but not usable by the steam cycle. (auth)

3024 (SLA-74-5168) ACCELERATED LIFETESTING AND FAILURE MODES OF THIN FILM W CONTACTS ON SiGe THERMOELECTRIC ALLOYS. Sweet, J. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 29p. (CONF-740426-2). Dep. NTIS $4.50.

From international reliability physics symposium; Las Vegas, Nevada, USA (2 Apr 1974).

The stability of sputtered thin film W contacts on heavily doped Si-Ge alloy was determined from measurements of contact resistance versus time for aging temperatures in the range 550 to 725°C. Contact failure time has been found to obey an Arrhenius type relation with an activation energy of 76 ± 5 kcal/mole and a projected lifetime of over ten years at temperatures below 460°C. Contact resistance remains approximately constant for the first 80% of contact lifetime and then increases rapidly through several orders of magnitude. These large contact increases are accompanied by contact deadhesion and buckling. Comparison of this data with that from diffusion experiments indicates that the activation energy for contact failure is comparable with that for the initial stages of WSi_2 layer growth in W-Si systems. (auth)

3025 UTILIZATION OF A TWO-TEMPERATURE, GAS-PARTICLE SUSPENSION IN MHD POWER GENERATION. Helfritch, D. J. Lafayette, IN; Purdue Univ. (1972). 136p. University Microfilms Order No. 74-4920.

Thesis (Ph. D.).

The use of a two-temperature, gas-particle suspension as the conducting medium in an MHD generator is considered. The gas temperature is significantly lower than the temperatures required to produce adequate electrical conductivity for pure gaseous phase MHD generation. Relatively hot, submicron particles supply high electron densities by means of thermionic emission. It has been shown that at relatively low pressures large gas-particle temperature differences can be attained through rapid nozzle expansion. Considering an argon-SrO suspension, nozzle expansion can yield a gas exit temperature of 1000°K and a particle exit temperature of 2000°K. The electron density generated by the two-temperature suspension has been calculated by means of a numerical solution of the Boltzmann and Poisson equations. The two-sided distribution function method has been used to replace the Boltzmann equation with a system of ordinary differential equations. It is shown that elevated electron densities may be achieved through the use of reduced gas temperature. The electrical conductivity of the suspension has been calculated considering electron-atom and electron-charged particle collisions. The spacial variation of the electron density due to electron sheaths is taken into account. It is shown that conductivities higher than 100 mho/m can be obtained for gas temperatures less than 1000°K. Optimum particle size, chamber conditions, and nozzle dimensions have been suggested based on maximum MHD power output. It is shown that total output power increases as gas temperature is decreased by means of continued nozzle expansion. Output power is also increased through the use of relatively large particles. (Diss. Abstr. Int., B)

3026 THEORY OF ALTERNATING-CURRENT ELECTRO-FLUIDDYNAMIC CONVERTERS. Kas'ianov, V. A.; Mkhitarian, A. A. Fluid Mech.-Sov. Res.; 2: 157-162(1973).

Linearized systems are considered. The solutions which are obtained are of interest from the point of view of qualitative analysis of the electrofluiddynamic (EFD) method of boundary layer control, when variable control voltage is used. The medium is assumed to be an incompressible colloid. The conversion section is a broad channel in which one-dimensional unsteady flow is produced between permeable flat electrodes. The solutions obtained are the first approximation for more complex problems in the field of EFD ac converters. (IAA)

3027 FUEL FOR MAGNETOHYDRODYNAMIC GENERATOR. Zeller, R. (to Maschinenfabrik Augsberg-Nurnberg Aktiengesellschaft). US Patent 3,801, 386. 2 Apr 1974. Priority date 24 Sep 1971, F. R. Germany. 8p.

A fuel is described for a magnetohydrodynamic generator in which readily ionizable seed material additives of potassium compounds, and if desired performance boosting metallic addi-

tives are suspended in a carrier liquid such as kerosene, benzene, toluene, or like fuel carrier hydrocarbons, with said seed material additive being an organo-metallic compound, namely $C_8H_{15}O_2K$. (Official Gazette)

3028 THERMOELECTRIC GENERATOR WITH THERMAL EXPANSION BLOCK. Sell, W. H. Jr. (to Isotopes, Inc.). US Patent 3,804,676. 16 Apr 1974. Filed date 14 Feb 1973. 8p.

A heat transferring device adapted for use in a thermoelectric generator which automatically compensates for shock, vibration, and thermal expansion is disclosed. The device consists of a relatively solid block composed of four slideably moveable arranged in opposing pairs so that the movement of one pair of wedges together causes the other pair of wedges to move apart, one pair of opposing wedges being provided with means biasing them together. (Official Gazette)

3029 EXPERIMENTS IN MHD POWER GENERATION WITH COAL AND LIQUID FUELS. Dicks, J. B.; Shanklin, R. V. III; Crawford, L. W. (Univ. of Tennessee, Tullahoma). Proc. Amer. Power Conf.; 35: 421-426(1973).

From the American Power conference; Chicago, Illinois, USA (8 May 1973). See CONF-730582-.

Experimentation at the University of Tennessee Space Institute on MHD power generation with coal and liquid fuels such as benzene is described. These are the first tests performed with MHD generation coupled with the coal combustor. Preliminary testing was performed by the British and the U. S. Bureau of Mines. The design of a coal injector is shown and when applied proved to be satisfactory for MHD combustion. Presently, nearly pure oxygen is being used to overcome the difficulty in small experimental equipment apparatus having excessive heat loss due to the unfavorable surface to volume ratio present in small-scale experiments. A diagram is shown of the combustion chambers giving satisfactory result when used with the injection plate coal and oxygen injector. The coal flow system is described. (MCW)

3030 LIQUID-METAL MHD FOR CENTRAL STATIONS. Amend, W. E. (Argonne National Lab., IL); Petrick, M.; Pierson, E. S. Proc. Amer. Power Conf.; 35: 427-435(1973).

From the American Power conference; Chicago, Illinois, USA (8 May 1973). See CONF-730582-.

The motivation for pursuing the development of liquid-metal MHD for commercial power systems is discussed. The two-phase liquid-metal MHD power cycle, which has potential for central station applications, is described and evaluated. The research required to substantiate the performance claims is outlined, and the present status of liquid-metal technology and some economic considerations are mentioned. (MCW)

3031 END EFFECT IN A LINEAR INDUCTION MACHINE TAKING INTO ACCOUNT THE SHUNTING FLUXES FROM THE STATOR BACK SIDES. Bugyanis, S. A.; Chesonis, V. I. Magn. Gidrodin.; No. 3, 140-142(1973). (In Russian).

A model of a linear three-phase asynchronous device which makes it possible to consider the effect of the shunting flux through the back sides of the stator was studied. The structure of the magnetic field in the air gap was determined in the no-load regime. (tr-auth)

3032 WEIGHT FUNCTION OF A PLANE CHANNEL AS A FUNCTION OF ELECTRODE LENGTH. Grinberg, G. Magn. Gidrodin.; No. 3, 143-144(1973). (In Russian).

A weight function is a dimensionless function of coordinates characterizing the specific contribution of a given channel point to the MHD-conversion process, in this case, to the creation of a difference in potential on the electrodes. The weight function W was calculated for a plane conduction MHD-channel having charged electrodes of finite length. Families of W-isolines as a function of relative electrode length are calculated and shown graphically. (SJR).

3033 SOME RESULTS FROM STUDYING FLOW STRUCTURE IN MODELS OF HELICAL CHANNELS OF LIQUID-METAL MHD MACHINES. Baranov, G. A.; Glukhikh, V. A.; Marinov, V. G.; Tananaev, A. V.; Ushakov, Yu. P. Magn. Gidrodin.; No. 3, 148-151(1973). (In Russian).

In order to decrease the active length of high-thrust electromagnetic pumps the working channels are frequently made helical. At small mass flows and high pressures the asynchronous MHD-generators with a helical channel have definite advantages over direct-flow converters. Hence determination of hydraulic losses and distribution of averaged velocities were found in helical MHD-machines. The hydraulic losses are given as: $\lambda = (2\,g\,\Delta H\,d_h)/(U^2L)$. Here ΔH is the pressure drop between measured cross-sections; L is the distance between measured cross sections; d is the hydraulic diameter equal to $2\,ab/(a+b)$; U is the velocity; a is the channel height and b is the horizontal length of the helix. The Reynolds number is: $Re = U\,d_h/\nu$. Here ν is the kinematic viscosity. At curvatures of $a/R < 0.33$ but > 0.14 (R is the rectangular radius of the channel) and $Re < 5 \times 10^4$ but $> 1 \times 10^4$ the resistance of helical channels is well described by the following formula: $\lambda = (0.316/Re^{0.25})\,[1 + 0.35(a/R)]$. At Reynolds numbers $> 5 \times 10^4$ the resistance of helical channels does not depend on the Reynolds number, but is determined only by the roughness and curvature of the walls. The effect of relative helical pitch with $h/R < 1.6$ but > 0.96 (here h is channel length) can be taken into account by using the following formula: $f = 0.316/Re^{0.25})\,[1 + 0.095\,(R/h)]$. (SJR)

3034 CALCULATION OF OPTIMAL PARAMETERS OF COMBUSTION CHAMBERS. Komkov, S. M.; Nosach. V. G. (Engineering Thermophysics Inst., Kiev). Heat Transfer-Sov. Res.; 6: No. 1, 141-144(1974).

Input data are presented of the results of optimal design of MHD generators in designing optimal parameters of combustion chambers for MHD generators for a cycle with chemical regeneration. The equivalent problem which, in its turn, makes it possible to obtain further optimization depending on the specific problem is discussed. (auth)

3035 SINGLE ELEMENT ΔT_{max} THERMOELECTRIC MEASUREMENT TECHNIQUE. Stanley, M. L.; Reich, A. D.; Ybarrondo, L. J. (Aerojet Nuclear Co., Idaho Falls, ID). Energy Convers.; 13: No. 1, 7-12(Jan 1973).

Two large-signal measurement techniques for determining the maximum operating performance of a single sample of thermoelectric material are presented. The experimental and analytical techniques presented are somewhat similar to the Harman Z (figure-of-merit of thermoelectric material) meter, with the distinction that they eliminate rather than correct for the problem of non-trivial lead interaction with the measurement. Predictions of thermoelectric material performance are compared with experimental measurements with good agreement. (auth)

3036 SPATIALLY DEPENDENT ELECTRON RELAXATION NEAR A THERMIONIC EMITTING ELECTRODE. Wu, F. T.; Shaw, D. J. (State Univ. of New York, Buffalo). Energy Convers.; 13: No. 2, 41-47(Apr 1973).

The spatially dependent relaxation phenomena in thermionic converters were investigated by a solution of the Boltzmann equation for free electrons and the rate equations for bound electronic states. The analysis shows that the electron distribution function during the relaxation can be described by two Maxwellian groups which eventually merge into one Maxwellian function. The rate of Maxwellization depends on electron–electron Coulomb and electron–neutral inelastic collision frequencies and is strongly coupled to the rate of relaxation of the bound-electron population toward Boltzmann equilibrium. Good agreement was found between the present theory and the available experimental data measured by the use of probe and spectroscopic techniques. (auth)

3037 ENERGY CONVERSION DYNAMICS. Messerle, H. K. (Univ. of Sydney). Energy Convers.; 13: No. 1, 19-23(Jan 1973).

A general approach to the transient analysis of energy conversion devices and systems is established by combining the concepts of energy conversion statics and irreversible thermodynamics. The approach leads directly to a state space representation of the performance relations for a system without the need for the invention of artificial loss functions and state functions as required when starting from classical electromechanics. In a system consisting of interconnected elements the connection relations lead to general transformations which are shown to be orthogonal due to the requirement of power invariance. (auth)

3038 DESIGNING MHD GENERATOR SYSTEMS FOR MINIMUM POWER PRODUCTION COSTS. Buende, R.; Raeder, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Energy Convers.; 13: No. 4, 143-148(Oct 1973).

The calculation of the thermodynamic and electrical data, on the one hand, and the power production costs, on the other, of a kerosene–oxygen fired supersonic MHD generator was taken as a starting point to study the influence of the design parameters on the power production costs. The results of this investigation allow optimum design of the MHD power plant as regards power production costs and operational safety. (auth)

3039 STABILITY OF NONEQUILIBRIUM MHD PLASMA IN THE REGIME OF FULLY IONIZED SEED. Nakamura, T.; Riedmueller, W. (Max-Planck-Institut fuer Plasmaphysik, Munich). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 5, 661-668(May 1974).

The stability of nonequilibrium MHD plasmas in the regime of fully ionized seed, taking into account the ionization of the noble

gas, was studied theoretically and experimentally. It is shown that the complete ionization of the seed is attainable with the discharge current and the corresponding electric field able to be achieved in actual MHD generators by reducing the seed fraction down to 10^{-5}. The experimental data show that in the regime of fully ionized seed the plasma is stable in agreement with the theoretical predictions. Effective Hall parameters as high as 6 were obtained, while the effective conductivity remained at the value of the laminar conductivity. The application of this stabilization method to actual MHD generators is discussed. (auth)

3040 ELECTRON NONEQUILIBRIUM IN OPEN-CYCLE MHD GENERATORS. Argyropoulos, G. S.; Demetriades, S. T.; Doss, E. D.; Oliver, D. A. (STD Research Corp., Arcadia, CA). 12: No. 5, 669-671(May 1974).

Localized regions close to the electrode walls of open-cycle MHD generators have high enough current density so that the free electrons are not in thermal equilibrium with the rest of the gas, even when the working fluid is such an effective absorber of electron energy as CO_2 or coal combustion products. The over-all electrical performance of open-cycle MHD generators depends critically on the presence and behavior of such thin nonequilibrium regions adjacent to the electrodes. These effects are demonstrated and analyzed by means of previously developed numerical modeling techniques. (auth)

Facilities and Equipment

Refer also to abstracts 2696 and 3583.

3041 (ANL-8016) EVALUATION OF A CLASS OF METHODS FOR BOUNDING STEADY-STATE CREEP DEFORMATION. Carey, J. J.; Valentin, R. A. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 45p. Dep. NTIS $4.00.

Theorems, due to Martin and Palmer, for bounding steady-state creep deformation are evaluated. Upper and lower bounds on the displacement rate at any point on the surface of a structure undergoing steady creep are determined in terms of arbitrary equilibrated stress distributions, and arbitrary consistent velocity fields. The theorems are applied to several problems for which exact solutions are known in order to assess the accuracy of the bounds based on a particular stress or velocity field. A procedure utilizing elastic finite-element analysis to compute the bounds is described, together with an example. (auth)

3042 (CEA-CONF-2575) COMPARISON BETWEEN EXPERIMENTAL AND COMPUTER ANALYSES OF THE BEHAVIOUR UNDER PRESSURE OF A 90° BEND WITH AN ELLIPTICAL SECTION. Vrillon, B.; Roche, R.; Baylac, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Electricite de France, 78 - Chatou). [nd]. 34p. (CONF-731003-9). Dep. NTIS (US Sales Only) $4.75.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

The development of industrial techniques requires a detailed analysis of the behavior of pressure vessels. The possible modes of failure must be taken into consideration. Calculation methods are generally based on an elastic analysis and hence it is necessary to understand the final results and to distinguish for example between different types of stresses, i.e., primary, secondary, peak, etc. This distinction is particularly difficult in some cases, including that developed here, which concerns a 90° bend of large diameter (about 2 meters) subject to a working pressure of 25 bars and possessing a central section in the form of a cylinder with an elliptical base. The characteristics of the structure led to the carrying out of two simultaneous analyses, by experiment and by computer analysis. The comparison of the results obtained was very instructive. The experimental analysis was performed on two mock-ups equipped with the appropriate instruments, i.e., electric strain gages, elongation transducers, etc. Load was applied by increasing pressure. Deformations were measured throughout the test. On these models it was possible to determine: the collapse load (in limit analysis), the plastic instability (bursting load), and the incremental collapse (shakedown), and thus obtain a direct indication of safety with respect to these modes of failure. The calculations were executed with the POCO computer system. This system contains the TRICO program which is capable of calculating three dimensional shells in elastic or elastic-plastic regime. (auth)

3043 (CEA-CONF-2576) USE OF COMPUTERS FOR PLASTIC ANALYSIS OF SHELLS: DESCRIPTION OF PLASTIC BEHAVIOUR AND LIMIT ANALYSIS METHODS. Hoffmann, A.; Roche, R.; Goldstein, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). [nd]. 32p. (CONF-731003-8). Dep. NTIS (US Sales Only) $4.75.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

The utility of the plastic analysis of pressure vessels was examined. A brief description of the work already accomplished in this field is given. Conventional plastic analysis methods can be used for shells; but for these a global plasticity model is proposed which takes tensile stresses and moments directly into account. Such a model is described. It leads to considerable simplification in the calculations. A few applications are described. The PASTEL programs in their axisymmetric version and POCO for shells of any shape were created for the elastic and plastic analysis of complex structures. (auth)

3044 (CONF-740330-1) VIBRATION FREQUENCIES AND MODAL SHAPES FOR MULTI-SPAN BEAMS WITH UNIFORMLY SPACED SUPPORTS. Gorman, D. J.; Sharma, R. K. (Ottawa Univ., Ontario (Canada)). [nd]. 18p. Dep. NTIS (US Sales Only) $4.00.

From seventh southeastern conference on theoretical and applied mechanics; Washington, District of Columbia, USA (21 Mar 1974).

A comprehensive analysis of the lateral vibration of uniform beams with equispaced intermediate supports has been conducted. All possible combinations of outer supports; namely, clamped, free or pinned; have been studied. Frequency data and modal shape expressions are provided for all cases. It is anticipated that these results will find much useful application, particularly in the design and development of heat exchangers and boilers. (auth)

3045 (CONF-740606-3) INELASTIC AND CREEP BUCKLING OF CIRCULAR CYLINDER DUE TO AXIAL COMPRESSION, BENDING, AND TWISTING. Griffin, D. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Dec 1973. Contract AT(11-1)-3045. 24p. Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Approximate solutions are given for the inelastic and creep buckling loads of circular cylinders under axial compression, bending, and torsion. Interaction equations are also given for various combinations of these loads. The inelastic solutions are based on small deformation-type stress-strain laws, stress and strain intensities defined by the octahedral-shear law, and the no-strain reversal model of buckling. The creep buckling solutions are obtained using isochronous stress-strain curves to approximate time dependent behavior. Based on the Rabotnov-Shesterikov stability criterion for the buckling of perfect shells, the method essentially replaces the time dependent problem with an equivalent time independent problem which is readily solvable. The simplicity of the solutions makes them well-suited for use in preliminary design analysis. (auth)

3046 (CONF-740606-4) STRESS ANALYSIS OF A RADIAL NOZZLE ATTACHED TO A CYLINDRICAL SHELL UNDER INTERNAL PRESSURE. Edmondson, A. J. (Tennessee Univ., Knoxville (USA)). [nd]. Subcontract 3025. 35p. Dep. NTIS $4.75.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

For Oak Ridge National Lab., TN.

An analytical method for the determination of stresses in the region of intersection of a thin-walled composite shell made from two right circular cylinders intersecting with axes perpendicular and subjected to internal pressure is presented. The governing equations are based on shallow, thin-shell theory and are limited to a ratio of cylinder radii of one-third or less. The formulations are written in terms of dimensionless groups to facilitate use of the analysis method in conducting parameter studies. Comparisons are made between the results obtained using the method and experimental data. The results of this investigation indicate that the analysis should prove to be a useful tool for conducting parametric studies within the specified range of validity. (auth)

3047 (CONF-740606-15) J INTEGRAL ANALYSIS FOR THE COMPACT SPECIMEN, CONSIDERING AXIAL FORCE AS WELL AS BENDING EFFECTS. Merkle, J. G.; Corten, H. T. (Oak Ridge National Lab., Tenn. (USA); Illinois Univ., Urbana (USA). Dept. of Theoretical and Applied Mechanics). 1973. 35p. Dep. NTIS $4.75.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

An important fracture mechanics problem is the determination of fracture toughness values will small specimens that fail after yielding. The J integral has an explicit meaning in terms of notch

tip conditions in the plastic range and can be calculated from single specimen test data. An improved J integral analysis is developed for the compact specimen by considering the combined loading that exists on the net section. The analysis agrees with linear elastic fracture mechanics in the elastic range and gives a result close to that given by the Equivalent Energy Method in the plastic range. (auth)

3048 (EURFNR-1127) ADVANTAGES AND DISADVANTAGES OF THYRISTORS FOR THE POWER SUPPLY OF ELECTRICALLY HEATED RODS OF HIGH POWER DENSITY. Krebs, L.; Malang, S.; Politzky, H. M.; Rust, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Oct 1973. 40p. Dep. NTIS $5.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Electrically heated rods are used to investigate the thermal conditions of fuel rods. Direct current systems as well as alternating current systems may be used as power supply of such rods. More and more thyristors are applied, what means the simplest and cheapest manner to regulate the power of heaters. However, in addition to the problems in measuring the power the regulation by phase control or pulse train control causes mechanical stresses in the heaters due to the time depending change of heat generation. The example of an indirectly electrically heated rod was used to investigate the mechanical effects of the phase control on the current conductor. (auth)

3049 (JAERI-M-5336) DYNAMIC ANALYSES AND EXPERIMENTS ON OWL-O FOR COMPUTERIZED CONTROL. Mankin, S. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 83p. (In Japanese). NTIS (U. S. Sales Only).

OWL-O (Oarai Water Loop-O), a boiling-water loop for the out-pile tests with JMTR, has been automated by means of a direct digital control system. The results of dynamic analyses and experiments made for system design are described, including formation of mathematical models, inherent dynamics, control characteristics and the comparison with experiments. Propriety of the linearlization of such a multivariable system is also discussed. (auth)

3050 (KURRI-TR-109, pp 123-130) COMPUTERIZED OPERATION OF OWL-O. Hara, M. (Japan Atomic Energy Research Inst., Tokai). 1973. (In Japanese).

An automatic operation of the OWL-O (out-pile boiling water test loop) has been tested for a practical development of the computerized operation of the JMTR inpile loops. The operation of the loop was fully automated from start-up to cooldown, and sequence monitoring was applied to pre-startup and post-cooldown checks. The computer functions consist of data acquisition, operation reporting, performance calculations, sequence control functions, operators' console functions and treatment of malfunctions. Steady state feed-back controls both of P- and B-mode are included in the sequence control functions. The system hardwares are made up with a Y-516 data processing system and with an operators' console and back-up stations. (auth)

3051 (SLA-73-7049) LARGE DEFLECTION ELASTIC-PLASTIC DYNAMIC RESPONSE OF STIFFENED SHELLS OF REVOLUTION. Stricklin, J. A.; Haisler, W. E.; Von Riesemann, W. A. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Aerospace Engineering; Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 65p. Dep. NTIS $6.25.

The formulation and check out problems for a computer code DYNAPLAS, which analyzes the large deflection elastic-plastic dynamic response of stiffened shells of revolution are given. The formulation for spacial discretization is by the finite element method with finite differences being used for the evaluation of the pseudo forces due to material and geometric nonlinearities. Time integration is by the Houbolt method or central differences. The stiffeners may be due to concentrated or distributed eccentric rings and spring supports at arbitrary angles around the circumference of the elements. Check out problems include the comparison of solutions from DYNAPLAS with experimental and other computer solutions for rings and conical and cylindrical shells. A hypothetical submarine including stiffeners and missile tube is studied under a combination of hydrostatic and dynamically applied asymmetrical pressure loadings. (auth)

3052 (UCRL-51563) NUMERICAL COMPUTATION OF DYNAMIC STRESS INTENSITY FACTORS BY A LAGRANGIAN FINITE-DIFFERENCE METHOD (THE HEMP CODE). Chen, Y. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1974. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

Numerical computation of the dynamic stress intensity factor for a centrally cracked rectangular bar, subjected to uniaxial tensions in plane strain geometry with Heaviside-function time dependence, is carried out using the time-dependent Lagrangian finite-difference code, HEMP. Excellent agreement was found with results obtained from other methods. This demonstrates the capability and the reliability of the HEMP code as an extremely useful numerical method for solving dynamic problems in fracture mechanics. Also discussed is the dynamic behavior of the stress intensity factor and crack opening. (auth)

3053 (UCRL-74879) ELFED: A COMPUTER CODE TO GENERATE FINITE ELEMENT MESH FOR PROBLEMS OF COMPLEX AXISYMMETRIC GEOMETRY. Schauer, D. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1973. Contract W-7405-eng-48. 19p. (CONF-740606-14). Dep. NTIS $4.00.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

ELFED is a computer program used to define a finite element network of complex description. ELFED can properly zone any body of revolution. First, the region of interest is divided into areas which may consist of a common material. The boundaries of these areas are called parts, and they are required ELFED input. Each part is then subdivided by ELFED into elements composed of three or four nodal points. After the geometry is completely specified, the user indicates how the defined parts are to be connected. Finally, ELFED numbers the nodes and elements in the manner specified to complete a finite element mesh. (auth)

3054 (UCRL-74978) NONLINEAR DYNAMIC ANALYSIS OF AXISYMMETRIC SOLIDS BY THE FINITE ELEMENT METHOD. Hartzman, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jul 1973. 27p. (CONF-740606-2). Dep. NTIS $3.50.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

A method for calculating the dynamic response of deformable axisymmetric solids, subjected to time-dependent axisymmetric loads is described. The nonlinearities considered in this analysis include material nonlinearity (elastic-plastic behavior) and geometric nonlinearity, which includes finite deformation. The finite-element method is applied to approximate the continuum by a lumped-mass system connected by axisymmetric elements. The equations of motion are solved by applying a step-by-step numerical technique. The analysis is illustrated by application to the collapse of a built-in spherical dome with varying thickness and to the impact of a cylinder against a rigid wall. Close agreement is obtained between the results from the present technique and results obtained from the literature. (auth)

3055 APPARATUS FOR PUMPING A HIGH PRESSURE LASER SYSTEM. Pan, Y. L.; Bernhardt, A. F.; Simpson, J. R. (to United States States Atomic Energy Commission). US Patent 3,795,874. 5 Mar 1974. Filed date 3 Nov 1972. 10p.

An apparatus is described for optically pumping a transversely excited, high pressure gaseous laser system by means of a double electrical discharge using a capacitor-bank network and electronic circuitry for implementing the method. Laser energy pulse outputs of approximately 17 Joules/liter at efficiencies of 24% have been obtained by the concept. (8 claims, 9 drawing figures) (Official Gazette)

3056 INFLUENCE OF THE QUALITY OF RUBY ON THE ACTIVE PARAMETERS OF THE LASER. Kvapil, J.; Perner, B.; Kvapil, J.; Sulosky, J. (Monokrystaly, Turnov, Czech.). Czech. J. Phys.; 24: No. 4, 389-394(1974). (In German).

The factors influencing the function of Verneuil and Czochralski laser ruby rods are described. Energy output is lowered by O^- color center formation, which is typical for the rods containing Mg^{2+} ions. The greater is the optical homogeneity of the rod, the better are the active parameters (including output energy) of the laser. (auth)

3057 PULSED CO_2 LASER HAVING AN INCREASED PRESSURE WITH PREIONIZATION ON THE CATHODE. Baranov, V. Yu.; Borisov, V. M.; Strel'tsov, A. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1522-1524(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 188-190(1973).

The construction of a CO_2 laser with improved parameters of the transverse discharge is described. The output energy amounts to 7 J/liter, and the pulse length at the half-height is 2 μsec for a CO_2: N_2: He = 2:1:3 mixture. (auth)

3058 CONVERTER ATTACHMENT BASED ON SOLUTIONS OF ORGANIC DYES FOR THE LTI-21 BATCH-MANUFACTURED NITROGEN LASER. Belokon, M. V.; Rubinov, A. N. (Inst. of Physics, Minsk). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1525-1527(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 191-192(1973).

A converter attachment based on solutions of organic dyes for a batch-manufactured nitrogen laser is described. A stable lasing operating mode with smooth tuning in the interval from 560 to 610 nm with a pulse repetition frequency of 50 Hz is ensured. (auth)

3059 METHOD AND APPARATUS FOR GAS-SOLUTION CONTACT IN A VESSEL. Melvanin, F. W. (to Eldorado Nuclear Ltd.). Canadian Patent 915,670. 28 Nov 1972.

An apparatus is described for mixing air with a liquid, as in the oxidative alkaline leaching of uranium ore pulp. The apparatus consists of an impeller and system of fixed vanes in a cylindrical tank. Preferably, there is an open-ended sleeve tube round the impeller. Bubbles are drawn down the center of the tank to the bottom, then rise nearer the side of the tank. The use of a weir to control the liquid level is claimed. (CA)

3060 INVESTIGATION OF HEAT AND MASS TRANSFER OF A VERTICAL STAGGERED BUNDLE OF TUBES IN A DISPERSED GAS/LIQUID FLOW. Ryzhkov, S. V.; Polovets, Yu. A. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 6, 123-127(Jun 1973).

Translated from Teploenergetika; 20: No. 6, 84-86(1973).

The investigation of mass transfer in a dispersed air/water flow has shown the existence of an approximate analogy between the processes of heat and mass transfer. The contact surface (the surface of mass transfer) in vertical bundles with flow of two-phase medium is not equal to the geometrical heating surface. To intensify the process of heat removal from rows of tubes deep in the vertical bundle the velocity of the dispersed gas/liquid flow should be higher than critical velocity (with respect to breaking off the film). (auth)

3061 THERMAL AND HYDRAULIC CHARACTERISTICS OF BUNDLES OF TUBES WITH TRANSVERSE FINS IN A LONGITUDINAL FLOW. Vinogradov, O. S.; Puchkov, P. I.; Ivanova, A. V.; Vovk, V. I.; Grivnin, A. I.; Telegina, E. P. (Central Boiler-Turbine Inst., Leningrad). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 6, 98-101(Jun 1973).

Translated from Teploenergetika; 20: No. 6, 70-72(1973).

Results of an investigation to obtain empirical formulas for calculating heat transfer and resistance of bundles of tubes with transverse fins in a longitudinal flow of a gaseous heat carrier are given. (TFD)

3062 LENSING EFFECT IN HELICAL TEA LASERS. Otis, G.; Tremblay, R. (Univ. Laval, Quebec). Can. J. Phys.; 52: No. 3, 257-264(1 Feb 1974).

A complete analysis of the lensing effect in helical TEA lasers is presented. Based on the theory of the gas lens, a theoretical model is developed and found capable of explaining the fast and slow time behavior of the lensing effect. It is also found that at the instant of laser emission, the helical TEA laser still presents a parabolic index of refraction profile. (auth)

3063 RETUNING HELIUM–NEON LASER WAVELENGTH FROM 3.3912 TO 3.3922 μm. Makhorin, V. I.; Popov, A. I.; Protsenko, E. D. Kvantovaya Elektron. (Moscow); No. 1, 47-55 (1973). (In Russian).

An investigation was made of the competition of lines with λ_0 = 3.3912 μm and λ_1 = 3.3922 μm in a helium-neon laser. It is theoretically determined that the maximum emission output on line λ_1 is equal to 50% of the power on line λ_0. The experimental output was 40% of the given power. The rate of decay of the lower level of line λ_1 is determined, and it is found that the rate of decay of the lower levels of these lines is independent of pressure. (Referativnyi Zh.)

3064 OPERATION OF A HEAT PIPE BEYOND THE CAPILLARY LIMIT. Holderness, J. H. Ann Arbor, MI; Univ. of Michigan (1973). 225p. University Microfilms Order No. 74-3645.

Significant reactivity effects are associated with the capillary failure of a heat pipe used to cool a nuclear reactor. These effects result from the void formed in the heat pipe wick when capillary action cannot supply sufficient condensate to the evaporator of the pipe. A sharp rise in the evaporator temperature accompanies this void. In order to evaluate these effects, the position of the void boundary and the evaporator temperature profile must be determined during the after capillary dryout. A one-dimensional time-dependent model is developed to describe the transient capillary dryout and recovery of a heat pipe. A numerical solution to the coupled energy and momentum equations is obtained for a step increase in power to a level above the capillary limit. From this solution a delay time is found to exist between the power step and the initial void formation. The rate of void formation is a function of both the power level and a characteristic heat pipe response time. Steady state conditions may ultimately be reached in which only a portion of the evaporator is voided. The extent of the steady state void depends on the falling capillary height of a column of liquid in the wick. As the power is decreased following capillary dryout, liquid advances into the dried wick. The position of the void boundary during recovery is a function of the recovery power level and the rising capillary height. Due to capillary hysteresis the recovery power level for complete recovery must be much less than the capillary limit. A heat pipe is constructed to demonstrate these effects experimentally. Thermocouples embedded in the wick are used to measure the temperature profile and to detect the position of the void boundary. Measured temperatures closely fit the predicted transient temperature profile. Steady state dryout is attained, and the effects of capillary hysteresis are noted during recovery. The rate of void formation is shown to be a function of the characteristic heat pipe response time and the power level. The dependence of the delay time on these two parameters is also demonstrated. (Diss. Abstr. Int., B)

3065 HIGH ENERGY OPTICAL LASER. Anderholm, N. C.; Gobeli, G. W. (to United States Atomic Energy Commission). US Patent 3,798,569. 19 Mar 1974. Filed date 15 Mar 1973. 6p.

A high energy optical laser is described which utilizes a coaxial pumping scheme having greater diameter than length coupled through a coaxial transmission line and a planar transmission line to a high-energy power source to induce a very high energy optical discharge at a wavelength in the pumping band of a lasing material. (Official Gazette)

3066 DEVICE FOR SAMPLING RADIOACTIVE AEROSOLS. Garnier, A. US Patent 3,802,250. 9 Apr 1974. Priority date 31 Oct 1969, France. 6p.

The device comprises a casing in which is formed an opening for the leak-tight assembly of a filter support by means of a bearing collar and which contains a compact storage battery for driving a constant-speed motor. The motor is associated with an eccentric which converts the movement of rotation of the motor shaft to a reciprocating movement of translation for an actuating link-rod which is connected to a bellows element having a generally cylindrical shape. One end of the bellows element is secured to the casing in the filter-support opening and the other end is secured to a closure plate. A check-valve is provided for suction through the filter and placed within the bellows element in front of a communication bore which is formed in the filter support and in the collar. A second check-valve is provided for delivery to the exterior of the casing and mounted on the bearing collar of the filter support in front of a duct which extends through the collar and opens into the interior of the bellows element. (Official Gazette)

3067 MODIFIED SEDIMENTATION TRAP. White, W. S.; Wetzel, R. G. (Michigan State Univ., Hickory Corners). Contract AT(11-1)-1599. Limnol. Oceanogr.; 18: 986-988(1973). (COO-1599-64).

A sedimentation trap with replicated, discrete upper and lower sections, which permit correction for nonsedimenting and attached organisms among sedimented matter, is described. A simple arrangement of the collecting framework on the supporting line allows one person to retrieve the collected material. (auth)

3068 NEW EQUIPMENT FOR WEAR TEST IN SODIUM. Okano, H.; Yamada, K. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 28: No. 11, 1237-1240(Nov 1973). (In Japanese).

In order to obtain fundamental data on mechanical components of sodium-cooled fast breeder reactors, new equipment has been wear tested in sodium. Accompanied by difficult problems as it was, the equipment is now satisfactorily operating with useful data being obtained. The equipment and the results of wear tests are described. (auth)

3069 PHOTORECOMBINATION LASERS (SURVEY). Bashkin, A. S.; Oraevskii, A. I. Kvantovaya Elektron. (Moscow); No. 1, 5-29(1973). (In Russian).

The physical principles of the theory of operation of photorecombination lasers are examined. An investigation is made into methods of creating pulsed and continuous lasers. Possible ways of realizing specific systems are considered. The main emphasis is laid on the advantages of photorecombination lasers, i.e., a wide band of working wavelengths (from the uv to the ir), the possibility of frequency tuning (at least 10%), and high efficiency. (Referativnyi ZH)

3070 IMPROVING THE MONOCHROMATICITY OF HYDROGEN CYANIDE LASER EMISSION. Dyubko, S. F.; Topkov, A. N. Kvantovaya Elektron. (Moscow); No. 1, 103-105(1973). (In Russian).

The operation of a hydrogen cyanide laser emitting on 336 μ m was studied. When carbon monoxide is added to the working mixture, the discharge current is reduced to 0.18 amp, while efficiency is more than tripled. The width of the emission line in operation with added CO is decreased by more than an order of magnitude. The paper gives the assumed mechanism responsible for the effect of CO on improving the population inversion of hydrogen cyanide working levels. On the basis of experiments a hydrogen cyanide laser is developed which operates effectively with a high-frequency discharge. The short-term stability of the hydrogen cyanide laser working with a high-frequency does not exceed 10^{-10}. (REFERATIVNYI ZH.)

3071 POPULATION OF LOWER LASER LEVELS IN A CARBON DIOXIDE LASER. Mikaberidze, A. A.; Ochkin, V. N.; Sobolev, N. N. Kvantovaya Elektron. (Moscow); No. 1, 41-46 (1973). (In Russian).

The vibrational temperatures of deformation vibrations of CO_2 molecules are measured by the method of rotating spectral lines in the 15-μm region. Comparison of the resultant vibrational temperatures with the calculated gas temperatures shows that the population of the lower laser levels is equilibrium in nature. Parallel measurement of the vibrational temperatures for antisymmetric vibrations of CO_2 molecules enables determination of the absolute population of the laser levels and inversion. The results are compared with measurements by the method of laser signal amplification. (REFERATIVNYI ZH.)

3072 DETERMINING THE OPTICAL POWER AND OPTICAL NONHOMOGENEITY OF ACTIVE ELEMENTS OF LASERS BY LINE TEST PATTERNS. Vassernis, R. I.; Kire'eva, S. I.; Tokmakova, V. P.; Sazonova, S. A.; Skorobogatov, B. S. Monokrist. Tekh.; No. 7, 77-82(1972). (In Russian).

A method is proposed for determining the optical power of an active laser element as a "pseudolens" and also the optical nonhomogeneity of elements on a collimator instrument with the aid of line test patterns. Correspondence is observed between the lenticularity measured on the instrument and that calculated from an interference pattern. It is demonstrated that elements can be presorted with respect to nonhomogeneity. (Referativnyi Zh.)

3073 DEVICE FOR MEASURING HIGH LEVELS OF LASER PULSE EMISSION ENERGY WITH LARGE BEAM DIAMETERS. Nikola'ev, V. K.; Khimichev, Yu. V.; Valitov, R. A.; Nadezhkin, Yu. M. Radiotekhnika (Moscow); No. 25, 8-14(1973). (In Russian).

The characteristics and design of a ponderomotive device for measuring the pulse energy of high-level transmitted emission are described. Problems of calibrating the meter are considered. Some components of measurement errors are evaluated. (Referativnyi Zh.)

3074 HEAT EFFECTS IN UNEVACUATED PONDEROMOTIVE LASER EMISSION METERS. Starodubtsev, G. P.; Nadezhkin, Yu. M.; Valitov, R. A. Radiotekhnika (Moscow); No. 25, 14-17(1973). (In Russian).

The thermal effects caused by convection of the air contained in a ponderomotive meter are considered. The effects which contribute most to the error in measuring the mechanical action of emission are singled out and investigated. Heat effects are studied over a broad dynamic range and as a function of the angle between the receiving element and the vertical, the location of the receiving element between the input windows, and the volume of the reception chamber of the meter. (Referativnyi Zh.)

3075 NUMERICAL CALCULATION OF AEROSOL PARTICLE CONCENTRATION PASSING THROUGH DIFFUSION TUBE. Kasahara, M.; Takahashi, K. Tech. Rep. Inst. At. Energy, Kyoto Univ.; No. 165, 1-31(Mar 1974).

The number and mass fractions of aerosol particles passed through a narrow diffusion circular tube were calculated as a function of the ratio of the tube length to flow rate. The equation of Gormley and Kennedy for diffusion tube theory was used to calculate the penetrations. The calculation was performed for polydisperse submicron aerosols of which particle size distribution was assumed to be log-normal with the geometric mean radius (r_g) from 10^{-7} to 1.5×10^{-6} cm and with the logarithmic standard deviation ($\log \sigma_g$) from 0 to 0.4. The results of the calculations are tabulated numerically and are illustrated by diagrams for some cases. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 3060, 3061, 3064, 3204, 3210, 3855, 5553, and 5614.

3076 (CEA-CONF-2486) GENERAL EQUATIONS OF BIPHASE FLOW. Application to Critical Flows and Nonpermanent Regimes. Boure, J.; Reocreux, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 20p. (In French). (CONF-7205108-1). Dep. NTIS (US Sales Only) $4.00.

From fourth conference of the Soviet Union on heat and mass transfer; Minsk, USSR (15 May 1972).

It is shown that in the general case the mathematical model of a biphase flow contains six conservation equations. The list of laws necessary to closing the system is established. Two applications are treated: critical flows and non-permanent regimes. With respect to these applications some supplementary hypotheses implicating models with four or five conservation equations are studied. The importance of the form of the laws used to close the system and the necessity for their in-depth study are shown. (tr-auth)

3077 (INIS-mf-979) HYPERCRITICAL ONCE-THROUGH VAPOR GENERATORS IN COUNTER FLOW WITH AND WITHOUT TWISTED TAPES. Cumo, M.; Farello, G. E.; Ferrari, G.; Maciuca, C. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). 1973. 18p. INIS.

From European two-phase flow group meeting; Brussels, Belgium (4 Jun 1973).

The influence of the swirl flow in once-through vapor generators was examined in the near critical region. Experiments were performed with indirect heating of Freon 12, flowing upward in a central duct, by water flowing downward in an annular gap, to avoid the shortcomings of the direct Joule heating of the ducts and to approximate actual situations. The total exchanged power, in the critical region, increases slightly in swirl flow with respect to the straight flow when the critical Freon temperature is reached at the outlet. But the "gain" attained with the insertion of twisted tapes is so little that it does not appear worthwhile, considering the shortcomings of plant complications, possibility of fretting corrosion, increasing of costs, and pressure drops. (INIS)

3078 (LA-UR-74-680) POOL BOILING HEAT TRANSFER TO LIQUID HELIUM AND LIQUID NITROGEN IN A NEARLY ZERO GRAVITY ENVIRONMENT. Edeskuty, F. J.; Williamson, K. D.; Taylor, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 14p. (CONF-740509-4). Dep. NTIS $4.00.

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A rocket-borne experiment was designed to obtain steady data on nucleate boiling heat transfer to liquid helium and liquid nitrogen in a nearly zero gravity environment. The experiment was successfully launched and was maintained at nearly zero gravity for five and one-half minutes. Under this condition the peak nucleate heat flux was reduced below the 1 g value. The results obtained are presented. (auth)

3079 (MRR-P-1) BLAST 2: A COMPUTER PROGRAM FOR TWO-PHASE FLOW OF WATER WITH LARGE PRESSURE DISTURBANCES TAKING INTO CONSIDERATION DELAYED ADJUSTMENT OF THE THERMODYNAMIC EQUILIBRIUM. Grillenberger, T.; Koeberlein, K. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jul 1972. 53p. (In German). INIS.

The digital program BLAST-2 calculates one-dimensional or quasi-one-dimensional flow of water in the single-phase and two-phase region. It is assumed that the flow is homogeneous and that the attainment of thermal equilibrium is delayed. The propagation of large pressure disturbances and critical state of flow can be treated in the program. A variable pipe cross-section dependent on location can be taken into consideration, as well as heat transfer as a function of location. (GE)

3080 HEAT DIFFUSION THROUGH MEDIA WITH NONCONDUCTING INCLUSIONS. Ferreira, S. (COPPE/UFRJ, Rio de Janeiro). Nucl. Eng. Des.; 26: No. 3, 404-407(1974).

A numerical solution for two-dimensional heat diffusion through a medium with non-conducting inclusions is presented. The procedure permits exact solution for the boundary conditions of the example considered. The numerical method (ADIP) used is stable for all time increments. It is fast and very simple to use for this kind of problem. (auth)

3081 MATHEMATICAL MODEL OF A NONISOTHERMAL TWO-PHASE FLOW IN A VERTICAL CHANNEL. Glushchenko, L. F. (Kiev Polytechnical Inst.). Teplofiz. Teplotekh.; No. 24, 97-101(1973). (In Russian).

The boundary conditions of two-phase fluid media are discussed during boiling. A system of differential equations is proposed to describe the behavior of a two-phase fluid flow in a vertical channel, taking into account the heat transfer. The properties of this

system are examined, and the system is characterized by one of a closed type which is solvable in principle when all the physical parameters and variables of the flow and the channel are available. (IAA)

3082 SPEED OF EXTENSION OF A PRESSURE DISTURBANCE IN LIQUID/GAS MIXTURES. von Boeckh, P.; Chawla, M. (Univ., Karlsruhe, Ger.). Brennst.-Waerme-Kraft; 26: No. 2, 63-67(Feb 1974).

It can be shown experimentally that the expansion rate of a pressure disturbance in an air/water mixture depends on the volumetric proportion of the steam in the mixture only. The various forms of flow, the amplitude, and the distance travelled by the pressure disturbance do not influence its speed of expansion. (GE)

3083 BEHAVIOR AND USE OF PLUGGING METERS IN LIQUID SODIUM SYSTEMS. Hamer, A. N.; Higson, J. H.; Mathison, J.; Swinhoe, R. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 59-64 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The response of plugging meters was studied under conditions where multiple temperature breaks were often observed, and the significance of this phenomenon is discussed. The behavior of oxygen in sodium was found to be unexpectedly complicated, and the existence of an unusual solubility equilibrium involving oxygen has been demonstrated. (auth)

3084 DETECTION OF SMALL WATER LEAKS IN SODIUM COOLED HEAT EXCHANGERS. Davies, R. A.; Drummond, J. L.; Adaway, D. W. (Dounreay Experimental Reactor Establishment, Eng.). pp 93-99 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

A program was carried out to evaluate the hydrogen measurement system installed in the PFR secondary circuit to detect the formation of small leaks between the sodium and water circuits. Measurements were made on the increase in the equilibrium pressure on addition of known quantities of hydrogen to the sodium. Data on the effect of sodium temperature and the presence of oxygen were obtained, and factors affecting the sensitivity and operation of the leak detection system are discussed. (auth)

3085 USE OF AN EDDY VISCOSITY MODEL TO PREDICT THE HEAT TRANSFER AND PRESSURE DROP PERFORMANCE OF ROUGHENED SURFACES. Lawn, C. J. (Central Electricity Generating Board, Berkeley, Eng.). Int. J. Heat Mass Transfer; 17: No. 3, 421-428(Mar 1974).

Calculations have been made of the velocity and temperature profiles for fully-developed turbulent flow in annular channels with roughened core rods. A unique set of boundary values for dimensionless velocity and temperature near the rough surface, together with a universal eddy viscosity model, serve to predict the friction factor and Stanton number of one particular surface in a wide variety of flow channels. Comparison with experimental data for nominally similar surfaces suggests that the method is accurate enough for practical purposes. (auth)

3086 INERT GAS EFFECTS IN THE INCIPIENT BOILING OF ALKALI LIQUID METALS. Bankoff, S. G.; Fauske, H. K. (Argonne National Lab., IL). Int. J. Heat Mass Transfer; 17: No. 3, 461-463(Mar 1974).

Unstable boiling of alkali metals from natural surfaces at low heat flux results in large variations in incipient boiling superheat. Work which demonstrated that extremely stable boiling with reproducible initial superheats could be obtained by using a single artificial cavity in a carefully controlled pool boiling system is discussed and the possibility is considered that large amounts of inert gas were trapped within the cavity. The theory of nucleation by entrained gas bubbles is further developed and it is concluded that inert gas plays a powerful role in determining incipient boiling superheat in alkali metals. (UK)

3087 IMPLICATIONS CONCERNING ROD BUNDLE CROSSFLOW MIXING BASED ON MEASUREMENTS OF TURBULENT FLOW STRUCTURE. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, WA); Johnson, B. M.; Knudsen, J. G. Int. J. Heat Mass Transfer; 17: No. 3, 407-419(Mar 1974).

An experimental study was performed to investigate the effect of flow channel geometry on fully developed turbulent flow in "clean" rod bundle flow channels, in order to obtain a better understanding of crossflow mixing between rod bundle subchannels. The experiments were performed in water with a Reynolds number range from 50,000 to 200,000. The experimental flow models considered pitch-to-diameter ratios of 1.25 and 1.125. Axial components of velocity, turbulence intensity and Eulerian autocorrelation function were the primary measurements. The autocorrelation function provided an indication of the dominant frequency of turbulence and an estimate of the longitudinal macroscale by using Taylor's hypothesis. A limited amount of lateral component turbulence intensity data was also obtained. Experimental results show that rod gap spacing (pitch-to-diameter ratio) is the most significant geometric parameter affecting the flow structure. Decreasing the rod gap spacing increases the turbulence intensity, longitudinal macroscale, and the dominant frequency of turbulence. These turbulence parameters are rather insensitive to Reynolds number. The results indicate that macroscopic flow processes exist adjacent to the rod gap. These include secondary flows and increased scale and frequency of flow pulsations when the rod gap spacing is reduced. When interpreted in terms of crossflow mixing, the results are consistent with present crossflow mixing correlations. (auth)

3088 REDUCED FORMULA FOR THE DYNAMIC-BIAS IN RADIATION INTERROGATION OF TWO-PHASE FLOW. Laratta, F. A. R.; Harms, A. A. (McMaster Univ., Hamilton, Ont.). Int. J. Heat Mass Transfer; 17: No. 3, 464(Mar 1974).

An alternate form is presented for the formula for the dynamic-bias appearing in radiation interrogation of two-phase flow, which was derived in a previous analysis. The reduced formula is algebraically simpler and permits a more intuitive appreciation of the dynamic-bias. (UK)

3089 GAS ENTRAINMENT AT THE FREE SURFACE OF A LIQUID. Entrainment Inception at a Laminar Vortex. Baum, M. R. (Central Electricity Generating Board, Berkeley). J. Brit. Nucl. Energy Soc.; 13: No. 2, 203-209(Apr 1974).

Experiments to determine the conditions necessary for the onset of gas entrainment at a laminar vortex were performed. A simple model is used to interpret these results and rules for modelling entrainment inception at a laminar vortex are proposed. These require the correct Reynolds number, Froude number, and Weber number to be used in a system which has the same ratio of liquid depth to outlet diameter as the prototype. (auth)

3090 NUCLEATE BOILING IN CRISIS OF HELIUM IN VERTICAL CHANNELS WITH NATURAL CONVECTION. Vishnev, I. P.; Vinokur, Ya. G.; Shaposhnikov, V. A.; Gorokhov, V. V. Heat Transfer-Sov. Res.; 6: No. 1, 170-176(1974).

The results are presented of an experimental study of nucleate boiling crisis of helium I in vertical annuli under natural-circulation conditions and of pool boiling at the surface of a vertical cylinder. The experiments were carried out at standard pressure. The effect on the nucleate boiling crisis of helium was examined of the passage geometries and also of the up and downstream non-heated lengths. Relationships are presented which approximate the experimental results with acceptable accuracy. (auth)

3091 EVALUATION OF THE CONDITIONS FOR THE SEPARATION OF VAPOR BUBBLES DURING NUCLEATE BOILING. Kirichenko, Yu. A. (Physical-Technical Inst., Kharkov). Int. Chem. Eng.; 14: No. 2, 265-269(Apr 1974).

The separation conditions of non-interacting vapor bubbles in which surface tension forces, internal forces, and drag forces are included are evaluated. (TFD)

3092 HEAT TRANSFER AT PULSATING LAMINAR FLOW. Hapke, J. (Krupp (Friedr.) G.m.b.H., Essen, Ger.). Brennst.-Waerme-Kraft; 26: No. 2, 55-63(Feb 1974). (In German).

In numerous devices and machines, the heat transfer at pulsating flow is of considerable importance. For the flow in tubes, the influence of pulsations on the transition from laminar to turbulent flow and from quasistationary to nonstationary behavior is examined. The relations for the quasistationary treatment of the heat transfer at pulsating flow are developed, and results of analytical heat transfer calculations are given for pulsating laminar flow in tubes and ducts. These results are compared to the experimentally determined influence of pulsations on the heat transfer. (GE)

Materials Testing

Refer also to abstracts 3405, 3409, 3469, 3912, 3913, and 3967.

3093 (UCRL-74745) ACOUSTIC EMISSION FROM STRESS RUPTURE AND FATIGUE OF AN ORGANIC FIBER COMPOSITE. Hamstad, M. A.; Chiao, T. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1974. 24p. (CONF-740411-3). Dep. NTIS $4.25.

From conference on composite reliability; Las Vegas, Nevada, USA (15 Apr 1974).

A series of tests was carried out to determine the scatter in acoustic emission data gathered during stress rupture and fatigue testing of a simple fiber-reinforced epoxy composite. Single-end organic fiber/epoxy strands were monitored for acoustic emission during tensile tests to failure, stress rupture tests, and dynamic fatigue tests. During the stress rupture and fatigue tests, the plots of summation of acoustic emission counts vs time were found to resemble metal creep curves in that primary, secondary, and tertiary regions could be distinguished. Because of a significant amount of scatter, only a limited correlation can be made between the slope of the summation of acoustic emission in the steady state region and the specimen life during stress rupture and fatigue testing. In addition, flawed specimens were easily sorted out during the tensile tests. These results indicate that acoustic emission data gathered during composite fatigue and stress rupture testing might be useful for life prediction. (auth)

3094 NONDESTRUCTIVE TESTING OF MATERIALS. Mueller, E. A. W. Arch. Tech. Mes. Messtech. Praxis; 455: No. 12, 229-232(Dec 1973). (In German).

A brief but comprehensive survey is given on x-ray radiography, gammagraphy, radiometric gages, neutron radiography, proton radiography, ultrasonic testing, acoustic emission testing, eddy current testing, magnetic flux testing, potential probe method, microwaves, exo-electron emission, IR thermography, holography, polarized lasers, and penetrant inspection. (GE)

3095 SEARCH FOR VOIDS IN A REACTOR CALANDRIA SAMPLE BY MEANS OF POSITRON ANNIHILATION AND ELECTRON MICROSCOPY. Kim, S. M.; Buyers, W. J. L.; Martel, P.; Carpenter, G. J. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 52: No. 3, 278-280(1 Feb 1974).

We have measured the positron annihilation angular distribution in 1S Al subjected to neutron irradiation while part of the NRX reactor calandria, in annealed 1S Al, and in heavily deformed 1S Al, which simulates the cold working of the calandria sample before irradiation. The FWHM in the calandria and deformed samples were found to be similar and 11% narrower than that in the annealed sample, indicating that the dominant defects in the calandria are dislocations rather than voids. Electron microscope examination of the above samples also indicated a high density of dislocations and no significant void population in the neutron irradiated calandria. (auth)

Nuclear Explosions

Refer also to abstracts 3145, 3194, 5688, and 5705.

3096 (AD-759531) MONTANA LARGE APERTURE SEISMIC ARRAY. Quarterly Technical Report No. 5, 1 December 1972–28 February 1973. Matkins, R. E. (Philco-Ford Corp., Billings, Mont. (USA)). 15 Mar 1973. Contract F33657-72-C-0390. 75p. NTIS $3.00.

The technical activity associated with the operation, maintenance, and improvement of the Montana Large Aperture Seismic Array (LASA) during the period 1 December 72 to 28 February 73 is reported. The short-period (SP) and long-period (LP) seismograph sensitivity performance statistics are indicated. The measured free period and mass position characteristics for the LP seismometer array are presented. Development of pseudo-random binary sequence (PRBS) calibration technique for the remote measurement of the amplitude, phase, and sensitivity characteristics of the LP seismograph over a broad band of frequencies is reported. Improvement to the PRBS calibrations recently developed for the SP seismograph is described. Statistics relating to the operation and maintenance of the array and data center equipment and land facilities support are provided. (auth)

3097 (AD-763490) FLOW INSTABILITIES IN RISING FIREBALLS. McCartor, G.; Messier, M. A.; Longmire, C. L. (Mission Research Corp., Santa Barbara, Calif. (USA)). Jul 1973. Contract DNA01-72-C-0114. 38p. (MRC-R-50; DNA-3077-T). NTIS $3.00.

An analysis of the linear stability problem for shear flows is presented and applications to fireball rise phenomena are discussed. (auth)

3098 (AD-763814) CURVATURE SPECTRA: APPLICATIONS TO SIGNAL DETECTION AND ESTIMATION OF THE RESOLVING POWER OF ARRAYS. McCowan, D. W.; Flinn, E. A. (Teledyne Geotech, Alexandria, Va. (USA)). Mar 1973. 44p. (AL-72-7; AFOSR-TR-73-1144). NTIS $4.25.

Curvature spectra convey roughly the same information as ordinary or high-resolution f-k spectra, with resolution intermediate between the two. The curvature of an array response function contains information about an array not supplied in the array response function itself. For example, the polarity of side lobes, i.e., whether they are small peaks or valleys, is better judged from curvature response plots. The differential response of an array provides a means of comparing the angular resolution of different arrays having the same signal detection sensitivity. Azimuth resolution of the infrasonic analog correlator detector is 0.95 mb. At 20 sec period and −200 m/sec phase velocity, experience shows that the angular resolution of the Huancayo microbarograph array is about one degree of azimuth, which implies that theoretically the angular resolution of LAMA, measured by the same technique is about one minute of arc. (auth)

3099 (AD-768638) QUARTERLY TECHNICAL SUMMARY REPORT, APRIL–JUNE 1973. Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 17 Jul 1973. Contract F33657-72-C-0009. 14p. NTIS $2.75.

The report summarizes the work done by the SDL during the period April through June 1973, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects. (auth)

3100 (AD-768927) AUTOMATIC ARRAY AND NETWORK DETECTION IN THE PRESENCE OF SIGNAL VARIABILITY. Blandord, R. R.; Wirth, M. H. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 1 Jun 1973. Contract F33657-72-C-0009. 67p. (SDL-308). NTIS $3.50.

Earlier theoretical work on automatic detection by an array or a network of arrays is extended to include the case where the signal amplitude varies log-normally between sensors or arrays. It was found that a "multi-array" detector which detects on the sum of the subsystem detector outputs is substantially superior to a "voting" detector. This result is in agreement with the few available empirical data. It is recommended that the multi-array detector be further evaluated using empirical data with a view to its use in worldwide networks and in arrays with widely spaced subarrays. Several other results are obtained which show that existing techniques for evaluating network thresholds are accurate for automatic detectors. (auth)

3101 (AD-769353) OPERATION OF THE TONTO FOREST SEISMOLOGICAL OBSERVATORY. Final Report, 1 July 1972–30 June 1973. (Teledyne Geotech, Garland, Tex. (USA)). 20 Sep 1973. Contract F33657-72-C-0800. 68p. NTIS $3.50.

Work accomplished on Project VT/3704 from 1 July 1972 through 30 June 1973 is reported. Project VT/3704 includes the operation, evaluation, and improvement of the Tonto Forest Seismological Observatory (TFSO) located near Payson, Arizona. It also includes information about research and test activities carried out at the TFSO and at Garland, Texas, using TFSO data. (auth)

3102 (AD-769914) IMPROVEMENTS IN THE TREATMENT OF COMPTON CURRENT AND AIR CONDUCTIVITY IN EMP PROBLEMS. Longmire, C. L.; Longley, H. J. (Mission Research Corp., Santa Barbara, Calif. (USA)). 25 Sep 1973. Contract DASA01-71-C-0105. 36p. (MRC-N-2; DNA-3192-T). NTIS $3.00.

Improvements in methods for treating the Compton current and air conductivity in EMP problems, including the effects of multiple scattering of the Compton electrons and formative time lag of the secondary ionization are presented. The problem of equilibration of low energy electrons is also discussed. (auth)

3103 (AD-770901) QUARTERLY TECHNICAL SUMMARY REPORT, JULY–SEPTEMBER 1973. Van Nostrand, R. G. (Teledyne Geotech, Alexandria, Va. (USA)). 15 Oct 1973. Contract F08606-74-C-0006. 15p. NTIS $2.75.

The report summarizes the technical work, support, effort, and data services completed during the quarter July through September 1973. The report is organized into Part A describing Operations and Maintenance functions (Tasks 1 through 4) and Part B describing Research (Tasks 5 through 8). In Part B, only work represented by completed technical reports is described. Since the current contract has replaced formerly separate contracts for the Seismic Data Laboratory and the Seismic Array Analysis Center, the work represented by these technical reports was largely done under the previous contracts. (auth)

3104 (FOA-4-4566-A-1) PHYSICAL PHENOMENA OF NUCLEAR EXPLOSIONS BELOW GROUND LEVEL AND NEAR GROUND LEVEL. Oscarsson, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1974. 51p. (In Swedish). Dep. NTIS (U. S. Sales Only) $5.75.

Physical phenomena in connection with nuclear explosions

near ground level causing craters and explosions far below ground level causing cavities are described. Differences between the two types of explosions are pointed out. A comparison with chemical explosions is made. The fate of the fallout of radioactivity from the explosion is described. Different applications of nuclear explosions for civil development are mentioned, e.g., producing water reservoirs, canals etc. The report is a literature study. (SW)

3105 (INIS-mf-1230) SOME PHYSICAL AND ENGINEERING IMPLICATIONS OF NUCLEAR EXPLOSIONS. O'Brien, B. J. (Australian and New Zealand Association for the Advancement of Science, Sydney (Australia)). Aug 1973. 18p. INIS.

From 45th ANZAAS congress symposium on nuclear explosions; Perth, Australia (13 Aug 1973).

A discussion is given of the potential uses of nuclear explosions in the following regions: (1) outer space, (2) upper atmosphere, (3) atmosphere, (4) surface or near surface, and (5) underground. The effect of the Starfish Event on the radiation belts of the earth is described and the economic benefits of nuclear excavation is discussed. A "benefit risk analysis" for nuclear explosions is given. The desirability of nuclear explosions in view of the risks involved is considered. (INIS)

3106 (NOL-TR-73-223) PROCEEDINGS OF THE FIRST CONFERENCE ON THE ENVIRONMENTAL EFFECTS OF EXPLOSIVES AND EXPLOSIONS, WHITE OAK, MARYLAND, MAY 30–31, 1973. Young, G. A. (comp.). (Naval Ordnance Lab., White Oak, Md. (USA)). 12 Feb 1974. 211p. (CONF-730581–).

Twenty-six papers were presented. A separate abstract was prepared for each of five. The remaining 21 papers on chemical explosions and chemical explosives were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 3107–3111.

3107 (NOL-TR-73-223, pp 46-51) ENVIRONMENTAL CONSIDERATIONS ON EVENT MIXED COMPANY. Shepard, W. B. 12 Feb 1974.

From 1st conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

In proceedings of the first conference on the environmental effects of explosives and explosions.

The Mixed Company Event was a 500-ton chemical explosive test detonated on November 13, 1972 near Grand Junction, Colorado. The test is described briefly, and some of the events which led to the filing of an environmental statement for the Mixed Company test are discussed. (LCL)

3108 (NOL-TR-73-223, pp 78-85) CHARACTERISTICS OF SHOCK WAVES IN WATER NEAR UNDERGROUND EXPLOSIONS. Merritt, M. L. (Sandia Labs., Albuquerque, NM). 12 Feb 1974.

From 1st conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

In proceedings of the first conference on the environmental effects of explosives and explosions.

The effects of shock waves from underground nuclear explosions detonated on Amchitka Island on nearby ocean water are discussed using data from photographic observations and ground motion and water pressure measurements obtained during the Long Shot, Milrow, and Cannikin Events. It was concluded that there are distinct differences in water pressures caused by explosions in the underlying rock as at Amchitka from the classically studied case of explosions in the water itself. Propagation nearly perpendicular instead of nearly parallel to the water surface changes a single interaction surface cutoff to a multiple interaction from repeated reverberations. Moreover, the slow rises characteristic of shocks that have travelled any distance through rock or soil result in water pressures with slow rises. After interaction with the surface, wave forms do not have sharp leading and trailing edges, and their amplitudes are not simply related to the accompanying particle velocities. Peak pressures decrease approximately linearly in amplitude, not duration, as the gaging point approaches the water surface. (LCL)

3109 (NOL-TR-73-223, pp 86-97) BIOLOGICAL EFFECTS OF UNDERGROUND NUCLEAR TESTING ON MARINE ORGANISMS. I. Review of Documented Shock Effects, Discussion of Mechanisms of Damage, and Predictions of Amchitka Test Effects. Simenstad, C. A. (Univ. of Washington, Seattle). 12 Feb 1974.

From 1st conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

In proceedings of the first conference on the environmental effects of explosives and explosions.

Investigations are discussed which were conducted to relate the effects of waterborne shock waves created by underground nuclear explosions upon organisms in the marine environment adjacent to the Amchitka Island test site. Information is included on the current level of understanding of shock wave effects on fish; the potential mechanisms of damage applicable to the Amchitka situation; the resulting prediction of effects formulated preparatory to the Cannikin test; and experimental approaches to documenting the actual effects of the test. (LCL)

3110 (NOL-TR-73-223, pp 98-106) BIOLOGICAL EFFECTS OF UNDERGROUND NUCLEAR TESTING ON MARINE ORGANISMS. II. Observed Effects of Amchitka Island, Alaska, Tests on Marine Fauna. Isakson, J. S. (Univ. of Washington, Seattle). 12 Feb 1974.

From 1st conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

In proceedings of the first conference on the environmental effects of explosives and explosions.

The physical effects of waterborne shock waves produced by underground nuclear explosions on Amchitka Island upon fishes, marine mammals, and birds are reported. Predictions and data from census counts and kill counts for the Long Shot, Cannikin, and Milrow Events are presented. Long Shot resulted in 2 dead cod, 3 dead diving birds, and no damage to the sea otter population. Milrow showed little evidence of impact on marine fishes, sea otters, and bird. One dead porpoise and no changes in the population sizes of bird species were found. The Cannikin Event resulted in thousands of seashore and offshore fish killed on both sides of the island. Fish species having air bladders were particularly sensitive to the blast-caused water pressure changes. A sea otter population decrease of 60% was observed in one area. Twenty-three dead or injured sea otters and 18 dead birds were recovered after the Cannikin Event. Autopsies revealed the damage was caused by rock-falls, vertical acceleration, and the effects of changes in water pressure. (LCL)

3111 (NOL-TR-73-223, pp 138-147) PROJECT TUGBOAT: EXPLOSIVE EXCAVATION OF A HARBOR IN CORAL. Day, W. C. 12 Feb 1974.

From 1st conference on the environmental effects of explosives and explosions; White Oak, Maryland, USA (30 May 1973).

In proceedings of the first conference on the environmental effects of explosives and explosions.

Project Tugboat was a chemical explosive excavation experiment planned to test the applicability of the cratering technique for harbor construction in a coral medium, to provide data which could be used in the development of both chemical and nuclear excavation technology, and to perform a useful portion of the excavation of a lightdraft boat harbor at Kawaikae Bay in Hawaii. The overall site investigation and project preparations are discussed. Post-shot measurements of crater size, seismic effects, air blast, effects on wildlife and fish, and damage to buildings are described. The three detonations used resulted in a channel of 12 ft minimum depth with a width varying from 150 to 260 ft. (LCL)

3112 (PB-226215) READY I SYSTEM FOR THE UNIVAC 1108 WEAPONS EFFECTS PROGRAM. Final Report. (General Services Administration, McLean, Va. (USA). Mathematics and Computation Lab.). Nov 1973. 31p. (GSA/OP/MCL-TM-231). NTIS $3.00.

This computer program, part of the READY I System, computes the effects of a specific nuclear attack on a set of resource points and produces a binary output tape containing the computed information. The results include probabilities of damage, direct effects casualty computations, fallout doses, fallout arrival times, fire likely indicator, and dominant weapon information. (auth)

3113 (UCID-16482) LONG-RANGE RESEARCH PROGRAM USING USAEC'S NEVADA TEST SITE AS AN EARTHQUAKE SIMULATOR. Tokarz, F. J.; Murray, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1974. Contract W-7405-eng-48. 23p. (CONF-740423-1). Dep. NTIS $4.25.

From national structural meeting; Cincinnati, Ohio, USA (Apr 1974).

Past, current, and planned efforts at the Lawrence Livermore Laboratory to establish a long-range earthquake research program using the US-AEC's Nevada Test Site as an earthquake simulator to investigate the response of full or large scale structures are discussed. The exciting force would be earthquake-like ground motion produced by underground nuclear explosives which are routinely detonated by the weapons test program. The presentation will indicate the results of a completed study showing the similarity of strong earthquake ground motion and ground motion produced by underground nuclear explosives. Emphasis here is with comparisons of peak ground motion values and response spectra values, and the to-date results of an analytical study comparing the inelastic dynamic response of five and ten story structures subjected to both strong earthquake motions

and those produced by underground nuclear explosions. Emphasis here is with duration effects on inelastic parameters such as ductility. Also included will be a discussion of the overall objectives of the research program, its mode of operations and the applicability of the Nevada Test Site to it. The advantages and disadvantages of the program as compared with some conventional experimental facilities are discussed. (auth)

3114 (UCRL-51414(Rev.1)) REVIEW OF SOVIET DATA ON THE PEACEFUL USES OF NUCLEAR EXPLOSIONS. Nordyke, M. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1974. Contract W-7405-eng-48. 49p. Dep. NTIS $4.00.

Over the last several years the Soviet Union has disclosed that they have a very active program for developing peaceful uses of nuclear explosions (PNE) in their national economy. They have described the results of 14 experimental and industrial explosions designed to develop nine different applications in the petroleum, gas, and minerals industries as well as for water resources development. However, when one considers the large number of large unidentified seismic events that have been reported over the last seven years in areas of the Soviet Union outside the normal nuclear-weapon test areas, it is obvious that they have an even more active program than they have publicly described, one that must be approaching a routine industrial technology in some areas. The PNE program that the Soviets have publicly discussed in various reports and at various meetings is summarized and, when appropriate, compared to data from the US Plowshare Program. (auth)

3115 (UCRL-51501) RIO BLANCO ELECTRONICS. Krause, O. H.; Carson, J. B.; Jaroska, M. F.; Spataro, S. J.; Russell, G. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Apr 1974. Contract W-7405-eng-48. 33p. Dep. NTIS $4.00.

The Electronics Engineering Department was responsible for the Integrated Control System (ICS) and the spall measurements program on the Rio Blanco Event. The ICS, consisting of a Control Point, Integrated Control Element, and the downhole system in each canister, was a modified version of the one used in the Miniata Event. After testing, assembly, and fielding, it performed successfully. The arming and firing cable was able to withstand severe environmental conditions and was novel in that it went through the explosive canisters rather than along the side of them. Spall was measured with CLIPER cables and 20 instrument canisters placed at a variety of locations both above and below the surface. The canisters contained various combinations of accelerometers and velocity gages. Spall was detected at all surface stations except one and at depths to 107 m. (auth)

3116 (UCRL-75080) NUCLEAR SOLUTION MINING: BREAKING AND LEACHING CONSIDERATIONS. Lewis, A. E.; Braun, R. L.; Sisemore, C. J.; Mallon, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Dec 1973. 12p. (CONF-740202-2). Dep. NTIS $4.00.

From AIME solution mining symposium; Dallas, Texas, USA (Feb 1974).

Large ore-bodies, too deep to mine economically by underground methods, may be mined using nuclear explosives and a high pressure leaching technology. Breaking of a hypothetical ore-body with a series of nuclear explosives is described. The leaching would be accomplished by pumping oxygen into the flooded rubble under the normal hydrostatic pressure. The injection of oxygen gas into the bottom of the rubble chimney induces a circulation of the solutions which carries dissolved oxygen to all parts of the chimney. Copper and other metals would be recovered from the solutions by solvent extraction as they are circulated through a surface plant in a closed system. This provides for control of pH as well as containment of radioactivity. Radioactivity levels in the solution are low, and no radioactive impurities are expected in the copper. This technology will allow production from deposits too deep to be of interest with present technology and will reduce or eliminate some environmental effects of conventional mining, such as open pits, mine dumps, tailings ponds, and SO_2 effluent. Close proximity of cities and towns is a limitation because of seismic damage. The technology requires further development for commercial application, and exploration targets must be enlarged to include deeper deposits, before the technology can be applied on a large scale. (auth)

3117 (UCRL-Trans-10701) TRANSLATIONS OF PAPERS PRESENTED AT THE THIRD PANEL ON THE PEACEFUL USES OF NUCLEAR EXPLOSIONS ORGANIZED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY HELD IN VIENNA, AUSTRIA, 27–30 November 1972. [nd]. Translation of French, Russian, and Spanish Papers. 241p. Dep. NTIS $7.60.

Thirteen papers are presented. A separate abstract was prepared for each of two papers. Eleven papers appeared previously in NSA. For abstracts of these papers see AWRE-Trans-65 in the Report Number Index. (LCL)

For abstracts of individual papers see: 3118 and 3119.

3118 (UCRL-Trans-10701, pp 1-46) DESIGN OF A WATERWAY CONNECTING THE ORINOCO AND RIO NEGRO RIVERS IN THE FEDERAL TERRITORY OF AMAZONAS, VENEZUELA. Paz-Castillo, F.; Kruger, P. 15 Nov 1972. Translation of a Spanish paper.

In translations of papers presented at the third panel on the peaceful uses of nuclear explosions organized by the International Atomic Energy Agency held in Vienna, Austria, 27–30 November 1972.

The Federal Territory of Amazonas in the southern part of Venezuela contains two major river systems, the Orinoco River and the Rio Negro, which, if extended and connected by a navigation channel, would greatly assist in the development of the Federal Territory and would provide an inland waterway to the Amazon River thereby expanding commerce between Venezuela and other South American countries. The design of such a waterway to be constructed using conventional and nuclear excavation technology is described. Information is included on the design criteria, geographical factors, waterway options, construction methods, project safety including radiological safety, environmental impact, and cost estimates. It is concluded that navigable waterways are essential to the future development of the southern part of Venezuela, that the proposed design would result in such a waterway, and that the continuation of this study can serve as a stimulus for developing international cooperation in the use of nuclear explosives for large excavation projects. (LCL)

3119 (UCRL-Trans-10701, pp 234-239) NATIONAL PROGRAM FOR THE USE OF PEACEFUL NUCLEAR EXPLOSIVES IN THE NATIONAL ECONOMY OF THE REPUBLIC OF VENEZUELA. Rodriguez Diaz, A. J. 27 Nov 1972. Translation of a Spanish paper.

In translations of papers presented at the third panel on the peaceful uses of nuclear explosions organized by the International Atomic Energy Agency held in Vienna, Austria, 27–30 November 1972.

Studies in Venezuela on the peaceful uses of nuclear explosives are discussed. These studies include evaluating nuclear excavation for the construction of an inland waterway between the Orinoco and Amazon Rivers, nuclear excavation of underground oil-storage reservoirs in the Gulf of Venezuela, use of underground nuclear explosives to enhance petroleum production from deep deposits of bituminous sands, fracturing of iron ore deposits, and uses of nuclear explosives for water resources development and waste disposal. (LCL)

3120 SUPERVISION ON THE BAN ON TESTING NUCLEAR WEAPONS. Dahlman, O. (Foersvarets Forskningsanstalt, Stockholm). Tek. Tidskr.; 103: No. 16, 22-23(12 Oct 1973). (In Swedish).

The weakness of international agreements on the limitation of production, testing, and use of atomic weapons, i.e., the supervision of these agreements, can be overcome by means of seismic instruments, which disclose that underground testing of atomic weapons has taken place. Swedish investigations have confirmed the suitability of seismic methods of supervision. Seismic instruments at Hagfors in Sweden can detect underground atomic explosions in North America, Europe, Africa, Asia, and the northern areas of South America. (SW)

3121 DRILLING MUD COMPOSITION FOR SHIELDING UNDERGROUND NUCLEAR EXPLOSIVE DEVICES. Heckman, R. A. (to United States Atomic Energy Commission). US Patent 3,808,128. 30 Apr 1974. Filed date 11 May 1972. 2p.

In underground nuclear explosive engineering applications, it is desirable to reduce the quantity of radioisotopes produced by neutron interaction with constituent elements of the surrounding soil. In order to effectively shield the surrounding soil, all void spaces around an emplaced underground nuclear device are filled with a drilling mud containing dissolved ammonium pentaborate as a neutron-absorbing shield. (Official Gazette)

3122 NUCLEAR BLASTING. Singh, D. P.; Saluja, S. S. (Banaras Hindu Univ., India). J. Mines, Metals Fuels; 21: No. 9, 253-259(Sep 1973).

Principles of nuclear explosives, cratering and chimney formation are discussed. The sequence of events in case of fully contained blasts as well as cratering blasts is described. Various applications of nuclear blasting and hazards are outlined. Mention is made of cost considerations. Likely applications of nuclear blasting in India are indicated. (auth)

Protective Structures and Equipment

Refer also to abstract 5827.

3123 RESULTS ON THE CONTROL OF THE EFFECTIVENESS OF A PROTECTIVE SUIT WHEN DISMANTLING A CELL

HIGHLY CONTAMINATED WITH TRITIATED WATER. Perotin, J. P.; Bouin, R.; Begault, J. C. (CEN de Saclay, Gif-sur-Yvette, France). pp 121-128 of Seventh National Congress of the Health Physicist's Association, Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Extensive results on the effectiveness of a particular protective suit in the dismantling of a cell highly contaminated with tritiated water are given. The suit was not constructed for this purpose. It is concluded from the results that the effectiveness of the suit depends on the amount to which it has been contaminated. (FR)

3124 TRITIUM ADSORPTION FACILITY. Fabian, H. (Nuklear-Chemie und Metallurgie GmbH, Grossauheim, Ger.). Kerntechnik; 16: No. 2, 63-64(Feb 1974). (In German and English).

A facility for the total extraction of tritium from air and waste gases is described. The facility works on the basis of hydrogen oxidation. The system is constructed so that it can bind equally well tritium contamination in the form of dust, vapor, and gas. Experimental measurements have shown that tritium can be extracted from air down to a residual concentration of 10^{-6} Ci/m^3. (GE)

3125 SAFE ESCAPE AIR LOCK FOR PERSONNEL IN NUCLEAR POWER STATIONS. von Hanffstengel, K.; Kober, K. J.; Marterstock, R. (Battelle-Institut e.V., Frankfurt am Main). Kerntechnik; 16: No. 2, 53-57(Feb 1974). (In German and English).

A personnel air lock for nuclear power stations with high catastrophic pressures in the containment which meets the requirements for maximum safety of escape in an MCA is described. The mechanisms of both sides of the air lock share a common automatic drive. Rectangular sliding doors are used because they show considerable advantages over hinged doors. Safety installations prevent injuries to personnel and a premature opening of the doors at an excessive overpressure. The design has proved highly satisfactory during the long-term trial corresponding to an operating time of 15 y. The requirements for personnel air locks in nuclear power stations according to DIN 25 406 have been met in a relatively simple manner. (GE)

3126 GRAZHDANSKAYA OBORONA. (Civil Defense). Titov, M. N.; Egorov, P. T.; Gaiko, B. A. Moscow; Vysshaya Skola (1974). 215p.

This textbook on civil defense presents data on the characteristics of atomic explosions (air, surface, underground, and underwater), poisonous gases, and harmful biological threats to life and health. Underground shelters of different sizes are described with required exits, entrances, and means of ventilation. The operation of radiometric and chemical survey instruments are described, and limiting radiation doses are discussed. The organization of civil defense among various enterprises is presented with stress on rescue work, first aid, and continuation of productive work. Evacuation and dispersal from cities with regrouping in the surrounding countryside is the basic plan for civil defense in the USSR. (SJR)

3127 FILTER EFFICIENCY IN CLEANING MINE ATMOSPHERES FROM DECAY PRODUCTS OF RADON. Akhmet, V. Kh.; Bushin, A. I. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 5, 137-140(May 1973). (In Russian).

Results are presented on experimental studies carried out in a horizontal uranium mine with the purpose of verifying the efficiency of one of the methods of obtaining a high degree of air purification from decay products of radon during filtration. This method consists of the use of stationary filters placed in succession along the entire length of the mine. Determination of the air contamination by daughter products of radon was carried out by an ore radiometer of the type RAN G-1. The required distance between filters was determined by direct measurement of the concentration of daughter products in the air stream after the filter. It is shown that the degree of contamination of the air stream passing from one filter to the other is greatly affected by leakage of contaminated air from the conduits, the ventilation flow velocity, radon entry into the mine, entry of daughter decay products from internal mine sources, and filter efficiency. (SJR)

3128 PROCESS FOR RETARDING FLOWING RADIOACTIVE NOBLE GASES. Schroeter, H. J.; Juentgen, H.; Zuendorf, D.; Knoblauch, K. (to Bergwerksverband GmbH). US Patent 3,803,802. 16 Apr 1974. Priority date 10 Dec 1970, F. R. Germany. 4p.

A process for retarding flowing radioactive noble gases which comprises conducting an exit gas or discharge gas containing such noble gases through a column filled with active carbon is described. (Official Gazette)

Safety Engineering

Refer also to abstracts 2853, 2854, and 3583.

Vacuum Engineering

3129 (RFP-Trans-155) APPARATUS FOR DETERMINATION OF OPTICAL PROPERTIES IN THE EXTREME ULTRAVIOLET OF EVAPORATED FILMS MAINTAINED UNDER ULTRA HIGH VACUUM (10^{-10} TORR). Daude, A.; Robin, S. Translated from Nouv. Rev. Opt. Appl.; 2: No. 1, 57-62(1971). 9p. Dep. NTIS $4.00.

This apparatus permits the optical study of films evaporated in a vacuum which is sufficient that the influence of the residual atmosphere on the formation of films may be neglected; moreover, the composition of this atmosphere is controlled. In addition, it permits the study of a large number of films, the thicknesses of which are known; the measurements can then be performed over several days or several weeks without being obliged to allow air to enter the apparatus; this assures a better vacuum and a time savings, and permits control of the evolution of films over long periods. It has allowed interesting results, of which a few are given, but it will facilitate much more the actually projected low-temperature measurements by diminishing the possible condensation of impurities on the samples. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

3130 (NCRD-12-72) SOLID WASTE POLLUTION IN ISRAEL. Report of the Committee to Study Solid Waste Pollution. (Israel National Committee on Biosphere and Environment, Jerusalem; National Council for Research and Development, Jerusalem (Israel). Life Sciences Div.). Jan 1973. 203p. INIS.

In recent years there has been great increase in public awareness of environmental quality. Solid wastes pollution is part of this concern. INCBE initiated this report to collect and evaluate the information which is necessary for determining national and local policy on solid wastes pollution. The various sources of solid wastes are examined and the ways of disposal are discussed. (INIS)

Minerals and Ores

Refer also to abstracts 3059, 3186, and 5705.

3131 (BARC/I-185) AUTOMATIC SPLITTER FOR WET TABLING OF RADIOACTIVE ORES. Nair, J. S.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 6p. INIS.

An automatic splitter developed for the efficient product collection in wet tabling of radioactive ores is described in detail. Results of tabling experiments using manual as well as automatic splitter are presented for uranium ores at Jaduguda, India. By using the device developed, it is possible to increase the recovery of uranium with optimum grade. (auth)

3132 (CONF-720724-P2, pp 453) HIGH-SPEED RADIOLUXOGRAPH WITH SINGLE-SCINTILLATION SENSITIVITY FOR AUTORADIOGRAPHY OF GEOLOGIC SAMPLES. Dooley, J. R. Jr. (Geological Survey, Denver). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The radioluxograph which has been used to localize and illustrate the distribution of uranium and thorium along with their alpha-emitting isotopes in flat sections of geologic samples is briefly discussed. A radioluxograph is an autoradiograph which uses the scintillations of visible light from a phosphor screen that is in contact with the rock surface on one side and with a photographic film on the other side where the radiographic image is produced. Extension of this technique to the use of ultra-high-speed film (ASA 10,000 speed) now available permits detection and location of a single alpha-particle disintegration site, when the alpha particle energy $\gtrsim$ 3 MeV. (WHK)

3133 GEOLOGICAL COMPARISON BETWEEN EAST EUROPEAN AND CANADIAN URANIUM DEPOSITS. Ruzicka, V. Geological Survey of Canada Paper 70-48. Ottawa; Information Canada (1971). 196p. $5.00.

The comparison of some geological features between the Canadian and East European (including the Asian part of U.S.S.R.) uranium deposits and types of deposits show many similarities, e.g. the deposits were formed during analogous mineragenetic processes, they were related to certain orogenies and to certain phases of the tectonic cycles in specific geological conditions. The distribution of the endogenetic uranium deposits is structurally controlled by regional deep fault and fracture systems, along which the tectonic movements were repeated several times. The intersections and ramifications of such systems are the favorable loci for uranium deposits, if other favorable conditions are present. Favorable lithological features of sedimentary rocks within the uranium-bearing areas and provinces influenced the localization of uranium mineralization in the sedimentary syngenetic deposits, or in the epigenetic deposits in sediments. The syngenetic differentiation and accumulation of uranium caused the primary enrichment of rocks with uranium. Weathering processes, which affected the uranium enriched rocks, separated the uranium compounds and introduced them either as a part of weathered material into the detritus or into the hydrological cycle. Metamorphic processes also participated in differentiation and accumulation of uranium. Comparison of some geological features of uranium deposits from different geological environments as well as the hitherto published classifications of uranium deposits allowed a new classification of uranium deposits into several syngenetic, metamorphic and epigenetic groups and various types within them. (auth)

3134 METHOD OF PROSPECTING. Milly, G. H. (to Geomet Mining and Exploration Co.). Canadian Patent 927,526. 29 May 1973.

Radioactive ore deposits can be found by tracking the emanation of radon or thoron from them under conditions of temperature inversion. An alpha scintillation counter is used to measure the radon or thoron content of air being sampled. In particular, under conditions of katabatic air flow, one can start at the bottom of a valley, and trace the downward flow of radioactive gas back up the valley to the orebody where it originates. (CA)

3135 DATING FAULTS BY FISSION TRACK DATING OF EPIDOTES: AN ATTEMPT. Bar, M.; Kolodny, Y.; Bentor, Y. K. (Hebrew Univ., Israel). Earth Planet. Sci. Lett.; 22: No. 2, 157-162(May 1974).

An attempt was made to determine the absolute age of faulting by measuring fission track ages of epidotes from mineralization veins along fault and joint planes. The method was applied to epidotes from along faults and fissures in the Sinai Peninsula, which cut Precambrian rocks. Most samples yield Tertiary ages (32 to 11 m.y.). An Early Cretaceous event is also recorded (120 to 103 m.y.). Samples from country rocks (igneous and metamorphic) give ages older than 325 m.y. The results are compatible with previous geological information, and suggest that the method can be potentially useful for dating faults. (auth)

3136 PRESENCE OF URANIUM IN ROCKS OF PHOSPHORITE FORMATIONS. Ostrovskaya, G. Ya. At. Energ. (USSR); 36: No. 3, 189-194(Mar 1974). (In Russian).

On the basis of formation generalization, an attempt is made for the first time to distinguish phosphorite formations in which a high concentration of uranium should be expected. Numerous data have been systematized and a formation method proposed by N. S. Shatski has been used. The most recent data have been added to the Shatski classification. It has been determined that there exist two basic types of uranium-phosphorus deposits, differing considerably both as to conditions of formation and sources of phosphorus and uranium as well as to their practical value. (1 table, 14 references) (auth)

3137 CHAIN DISINTEGRATION OF URANIUM IN NATURE. Vobecky, M. (Ustav Experimentalni Mineralogie a Geochemie, Prague). Chem. Listy; 68: No. 4, 374-377(Apr 1974). (In Czech).

An analysis of papers is given that confirms the possibility of a chain fission of uranium in nature. (auth)

Radioactive Effluents

Refer also to abstracts 2837, 5361, and 5695.

3138 (BNWL-SA-4962) NUCLEAR RADIATION: SOURCES AND IMPACT. Unruh, C. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-1830. 29p. (CONF-740434-1). Dep NTIS $4.50.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

Data on the sources of radiation exposure of human populations in the USA and the average annual dose resulting from each source are reviewed. The radiation dose from the nuclear power industry is at the bottom of the list in terms of quantity of dose and consequently in terms of impact on man. Nevertheless, waste management programs throughout the nuclear power industry are designed to keep radiation impact on man at the level as low as practicable regardless of the inconsequential impact. It is estimated that in the year 2000 with 1,000 nuclear power plants in operation, the average annual dose from this industry will be less than 0.4% of the unavoidable natural background radiation levels. (CH)

3139 ATMOSPHERIC PROBLEMS, AIR POLLUTION: A COMPREHENSIVE REVIEW. Odabasi, H. (Univ. of Colorado, Boulder). pp 57-110 of Environmental Problems and Their International Implications. Odabasi, H. (Ed.). Boulder, CO; Colorado Associated Univ. Press (1973).

From conference on international implications of environmental problems; Istanbul, Turkey (21 Jul 1971). See CONF-710743-.

Radioactive aerosols found in the atmosphere are classified as cosmogenic, radiogenic, and man-made and the source of each class is discussed. It is pointed out that man-made radioactive nuclides may be introduced into the atmosphere during nuclear or thermonuclear detonations, radioactive leakage from nuclear power plants, or during bomb making, fuel reprocessing, or from radioactive wastes. The factors involved in the formation of radioactive aerosols in the atmosphere are reviewed. Other topics

discussed include the chemical constituents of non-polluted atmosphere, and sources of pollution by non-radioactive aerosols, sulfur oxides, carbon monoxide and carbon dioxide, nitrogen oxides, lead, barium compounds, particulate matter, and other chemical pollutants. The health hazards of air pollution are discussed briefly and methods are suggested for the control of air pollution. (CH)

3140 ENVIRONMENTAL PROBLEMS AND THEIR INTERNATIONAL IMPLICATIONS. Conference Held at Istanbul, Turkey, July 21–28, 1971. Odabasi, H.; Ulug, S. E. (eds.). Boulder, CO; Colorado Associated University Press (1973). 193p. (CONF-710743-). $10.00.

A separate abstract was prepared for one chapter that discusses sources of radioactive contamination of the atmosphere. Ten additional chapters discuss various environmental aspects of land and water use. (CH)

For an abstract of an individual chapter see: 3139.

Radioactivity Monitoring and Transport

Refer also to abstracts 3356, 3482, 5701, and 5715.

3141 (BNWL-SA-4840) LOG-NORMAL STATISTICS APPLIED TO THE PLANNING, COLLECTION, AND ANALYSIS OF PREOPERATIONAL ENVIRONMENTAL SURVEILLANCE DATA. Waite, D. A.; Denham, D. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 14p. (CONF-740603-1). Dep. NTIS $4.00.

From 2nd international conference on radiation protection–philosophy and implementation; Aviemore, UK (2 Jun 1974).

The operator of a nuclear establishment may be held responsible only for radioactive material which the particular plant has added to the environment. Determination of this environmental addition via a routine environmental surveillance program can be enhanced through the use of log-normal statistical techniques. Basic principles and advantages of using log-normal techniques to plan, collect, and analyze environmental data are discussed. Applicability of log-normal analysis during the planning phase and to interrelationships between such difficult decision variables as: (1) sample media, (2) sample volume, (3) sample collection frequency, (4) minimum environmental detection limit, and (5) incorporation of existing data are detailed. Applications to problems commonly encountered in the collection and analysis of preoperational data are addressed. Specifically mentioned are the determination of sample representativeness, the identification of typical environmental levels and expected upper limits, and seasonal or yearly variations in background. (auth)

3142 (CEA-CONF-2513) HEALTH PHYSICS ASPECTS OF NUCLEAR POWER PRODUCTION. Jammet, H.; Mechali, D.; Lacourly, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 16p. (In French). (CONF-730983-4). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

Radioactive pollution from wastes produced normally or accidentally by nuclear power plants can result in the exposure of a certain group of the population to radioactivity. In normal operation, protection is ensured by establishing maximum dose limits and setting up an appropriate monitoring system to ensure that they are respected. Accident risks are reduced by establishing intervention limits and preparing emergency plans to limit the damage that might result. (FR)

3143 (CEA-R-4570) ENVIRONMENTAL PROTECTION AND RADIOECOLOGY. Rouhanizadeh, N. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). May 1974. 25p. (In French). Dep. NTIS (US Sales Only) $4.25.

The preservation of our environment is one of our present major concerns, all the more as human activities are producing wastes whose storage and disposal are likely to become, sooner or later, potential hazards to health and environmental quality. An exhaustive introductory review is presented of environmental parameters, especially those concerning the transfer of contamination from the pollution sources to man (atmosphere, water, soil, plants, animals, materials). The conditions of validity of these parameters are developed so as to supply scientists or public health authorities with useful reference data. (auth)

3144 (MHSMP-74-12) ENVIRONMENTAL MONITORING REPORT FOR PANTEX PLANT COVERING 1973. Alexander, R. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1 May 1974. Contract DA-11-173-AMC-487(A). 44p. Dep. NTIS $5.25.

Although Pantex Plant operations involve the handling of significant quantities of uranium, plutonium, tritium and toxic chemicals, safeguards have precluded potentially hazardous releases of these materials. Release of materials has been restricted to small amounts of natural uranium depleted in the isotope ^{235}U (essentially ^{238}U) and tritium which might be found in the local environment at slightly higher than background levels. Concentrations of these nuclides are well below the accepted criteria, however, and do not present a public health hazard. (auth)

3145 (NERC-LV-539-31) ENVIRONMENTAL MONITORING REPORT FOR THE NEVADA TEST SITE AND OTHER TEST AREAS USED FOR UNDERGROUND NUCLEAR DETONATIONS, JANUARY THROUGH DECEMBER 1973. (National Environmental Research Center, Las Vegas, Nev. (USA)). May 1974. Contract AT(26-1)-539. 110p. Dep. NTIS $5.45.

Data are presented on the levels of radioactivity in off-site environmental samples collected during 1973 in the vicinity of the Nevada Test Site and the site of the Gasbuggy underground nuclear explosion. Data are included on the content of ^{85}Kr, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{90}Sr, and tritium in samples of underground water, surface water, surface air, and vegetation. Samples of food crops, drinking water, and milk were also analyzed for radioactivity above naturally occurring level. (CH)

3146 (RISO-M-1696) CAUSES AND PREVENTION OF ACCIDENTS. Rasmussen, J. (Danish Atomic Energy Commission, Risoe, Research Establishment). Feb 1974. 25p. (In Danish). Dep. NTIS (U.S. Sales Only) $4.25.

A summary is presented of general features of radiation accidents from 17 English-language reports and counter-measures that may be the basis for a risk calculation. The difficulties in determining criteria for acceptable risk are touched upon, and conclusions from published accident statistics are briefly summarized. (DE)

3147 (SSI-1974-1) AMOUNT OF CESIUM-137 IN DAIRY MILK, 1973. Hagberg, N. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Mar 1974. 9p. (In Swedish). Dep. NTIS (U. S. Sales Only) $4.00.

The content of ^{137}Cs in dairy milk in Sweden has been monitored since 1962. The results of all measurements on dairy milk during 1973 are presented. (SW)

3148 (SSI-1974-3) CONTENT OF CESIUM-137 IN SWEDISH REINDEER MEAT, 1973. Primary Data Report. Swedjemark, G. A.; Hagberg, N. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1974. 5p. Dep. NTIS (U. S. Sales Only) $4.00.

Measurements of the content of ^{137}Cs in deep-frozen reindeer meat have been made since 1961. Data from the measurements during 1973, summary of results for the period since 1969, and time variations of the average concentration are presented in tables and figures. During the period investigated, the values obtained for the autumn slaughters prior to that of 1968 have been significantly lower than the values obtained for the winter slaughters. Since then the seasonal variation has been less pronounced. (SW)

3149 (SSI-1974-5) CORRELATIONS BETWEEN CESIUM-137 LEVELS IN MEAT AND MILK, 1973. Primary Data Report. Swedjemark, G. A. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Feb 1974. 3p. Dep. NTIS (U. S. Sales Only) $4.00.

The content of ^{137}Cs in meat and milk has been measured in Sweden since 1963. Monthly averages of ^{137}Cs concentrations in beef and pork for the whole country have been calculated from values of ^{137}Cs in milk and compared to observed activities. Results are shown in two figures, one for beef and one for pork. (SW)

3150 (SSI-1974-6) RATIO BETWEEN CESIUM-137 AND STRONTIUM-90 IN MILK, 1973. Primary Data Report. Swedjemark, G. A. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Feb 1974. 5p. Dep. NTIS (U. S. Sales Only) $4.00.

The content and ratio between ^{137}Cs and ^{90}Sr in milk from nine dairies in Sweden for 1973 is described in a table. For most of the dairies the values have decreased from the previous year, mainly due to decreasing Cs values. (SW)

3151 (SSI-1974-13) FORMAL GROUNDS FOR HOW THE NATIONAL INSTITUTE OF RADIATION PROTECTION DEALS WITH QUESTIONS CONCERNING NUCLEAR POWER PLANTS. Hesser, C. G. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Mar 1974. 2p. (In Swedish). Dep. NTIS (US Sales Only) $4.00.

According to a Swedish law the National Institute of Radiation Protection is responsible for supervising radiological work in Sweden, which includes nuclear power plants. This means that the

National Institute of Radiation Protection is responsible for controlling releases of radioactivity into the environment, exposure of personnel to ionizing radiation, controlling emergency services, etc. The National Institute of Radiation Protection is not responsible for the technical construction of nuclear reactors. (SW)

3152 RADON IN NORWEGIAN MINES. Radiation Underground Can Lead to Injuries. Myran, T. (Trondheim Univ., Norway); Berteig, L. A. Tek. Ukebl.; 121: No. 9, 22-24(28 Feb 1974). (In Norwegian).

The decay chain of ^{238}U to ^{222}Rn is presented and the decay of ^{235}U and ^{232}Th to ^{219}Rn and ^{220}Rn respectively are mentioned. The daughter products of ^{222}Rn are also presented. These are metallic atoms which rapidly attach themselves to aerosol particles in air. The probability of the retention of radon daughters in the upper and lower respiratory tracts are given as a function of the aerodynamic diameter. The ICRP's maximum permissible concentration for ^{222}Rn in equilibrium with its daughters is 30 pCi/l air for 2000 working hours/year. It was found in 1970 that this level was exceeded in 22 of 53 mines inspected in Sweden. Inspection of Norwegian mines was started in 1971 and 27 mines and 5 tunnels have been inspected. The results are summarized in a table. In general the radon and radon daughter concentrations were well below the MPC levels and no countermeasures are found to be required. Dust and diesel and blasting fumes constitute greater potential risks to health. Inspection will be continued in those mines with an average radon daughter concentration higher than 10 pCi/l and in all new mines. (NO)

3153 GRADIENT OF CAESIUM IN THE OCEAN. Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, CA). Nature (London); 248: No. 5445, 216-217(15 Mar 1974).

It is stated that specialized analytical equipment has recently become available at the Scripps Institution for determination of traces of natural Cs, and tested with North Pacific water samples. The measurements appeared to show, for the first time, a significant difference between Cs concentrations at the sea surface and in deeper water. They also emphasized the uniformity of Cs concentrations in deep Pacific water masses, and the great similarity of Cs concentrations, normalized against salinity, at Pacific surface stations thousands of miles apart. The new procedure is a computerized version of emission flame spectrometry, used after relatively large samples have been concentrated by the method of Feldman and Rains [Anal. Chem. 36:405 (1964)]. Data obtained are shown graphically. Significant implications for ^{137}Cs are discussed. (UK)

Atmosphere

Refer also to abstract 3326.

3154 (AECL-4598) AIR SAMPLING FOR IODINE-125. Holford, R. M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1974. 17p. Dep. NTIS (US Sales Only) $4.00. AECL $0.50.

In monitoring for airborne ^{125}I, self-absorption in the filter on which iodine is collected is a problem because of the low energy of the emitted radiation. Therefore recommended techniques for air sampling at the production facility and the processing laboratory require the use of charcoal-containing filters made of low Z materials. Provided self-absorption is not excessive, absolute disintegration rates for ^{125}I can be calculated directly from pulse-height spectra by a method using the coincidence properties of the radiation. (auth)

3155 (ARMS-68.6.7) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING THE HALLAM NUCLEAR POWER FACILITY, HALLAM, NEBRASKA, SEPTEMBER 20, 1968. (EG and G, Inc., Las Vegas, Nev. (USA)). May 1974. 16p. (EGG-1183-1590). Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Hallam Nuclear Power Facility during September 1968, four years after reactor shut-down. The survey measured terrestrial gamma radiation. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 200 square mile area showing isoexposure contours three ft above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background. (auth)

3156 (INIS-mf-887-1, pp 46-73) PROBLEMS OF PHYSICAL MEASUREMENT OF FISSION PRODUCTS IN BIOSPHERE. Prochazka, H. (VUVL CAZ, Brno); Jilek, R.; Katzer, J. [nd]. (In Czech).

The main causes of contamination of the biosphere encountered in the industrial application of nuclear energy (water management of the light water reactor, nuclear explosions for peaceful uses, mining and dressing of uranium ores) are listed. An analysis is made of methods suitable for the direct determination of the intensity and the energy of nuclear radiation, including instruments for detection and spectrometry. Liquid scintillation detectors are dealt with in more detail. The results are given of the tests of the commercially produced liquid scintillators SLD-31, SLE-31, SLS-31, SLX-31, SLT-31, and Insta-gel. Principles of sampling are cited. (INIS)

3157 (UCRL-51462) ADPIC: A THREE-DIMENSIONAL COMPUTER CODE FOR THE STUDY OF POLLUTANT DISPERSAL AND DEPOSITION UNDER COMPLEX CONDITIONS. Lange, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Oct 1973. Contract W-7405-eng-48. 62p. Dep. NTIS $5.45.

In line with the widening need and effort in the field of pollutant transport and diffusion studies from local to extended regional scales, it has become apparent that a fully three-dimensional approach must be taken, and in order to do computer studies, three-dimensional computer codes must be developed. ADPIC is such a code. It is a three-dimensional, Cartesian, particle-diffusion code, capable of calculating the time-dependent dispersion of inert or radioactive air pollutants under many conditions, including stratified shear flow, calms, topography, and wet and dry deposition, for individual or multiple instantaneous or continuous sources and space- and time-variable diffusion parameters. The code solves the three-dimensional diffusion-advection equation by the pseudo-velocity technique for a given mass-consistent advection field. The method is based on the particle-in-cell technique with the pollutant concentration represented by Lagrangian particles in an Eulerian grid mesh. ADPIC has been verified for a number of selected advection-diffusion problems for which analytic solutions are available, and has been found to give results to within ±5% of the analytic solutions. (auth)

3158 RELATIVE SENSITIVITY OF THE MEASUREMENTS OF RADIOACTIVE WASTE IN DISPOSAL IN AIR AND WATER. Boulenger, R. (Controle-Radioprotection, Mol, Belg.); Colard, J.; Koch, G. J. Belge Radiol.; 56: No. 5, 439-441(1973). (In French).

This paper is limited to the study of the relative sensitivity of measurements of radioactive wastes in air and in water; it is shown that the sensitivity of the methods of measurements allows the detection of small fractions of the environmental radioactivity level. (auth)

3159 EFFECT OF RECOIL NUCLEI BEING KNOCKED OFF AEROSOL PARTICLES ONTO FREE-ATOM CONCENTRATIONS OF DAUGHTER EMANATION PRODUCTS. Kolerskii, S. V.; Kuznetsov, Yu. V.; Polev, N. M.; Ruzer, L. S. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 10, 1527-1530(Oct 1973).

Translated from Izmer. Tekh.; 16: No. 10, 57-58(Oct 1973).

At present it is thought that the emanation atoms are not attached to aerosol particles suspended in air and, therefore, the free atoms of the first daughter emanation product are formed only by the disintegration of free emanation atoms. However, the free atoms of the second and all subsequent daughter products can be formed in two ways, namely, from the free atoms of the preceding isotope in the course of disintegration, and from the atoms of the preceding isotope, which are attached to the aerosol particles, disintegrate, and are knocked off the particles owing to the recoil effects. A method is suggested for determining experimentally the ejection factor of the daughter emanation-product atoms from the aerosol particles produced by the recoil effect during the atom's disintegration. Measurements were made on the free-atom fractions of radon daughter products in a chamber where the air was enriched with radon. When the amount of dust in air starting from low values (small values of λp) increases, the amount of attached RaA atoms increases as well as that of the attached RaA atoms subjected to ejection. For $N = N(max)$ the ejection of disintegrating RaA atoms and their secondary attachments to aerosol particles balance each other. For $N > N(max)$ [$\lambda_p > \lambda_p(max)$] the secondary attachment of ejected atoms to aerosol particles exceeds their ejection and with a further rise of the content of dust in air the part of the free RaB atoms' fraction due to the knocking off of the RaA atoms attached to the aerosol particles from those particles decreases. (JGB)

Soil

3160 (IAEA-R-599-F) DISTRIBUTION AND CYCLE OF RADIONUCLIDES AND RELATED TRACE ELEMENTS IN MARINE ENVIRONMENT. Part of a Coordinated Programme On Marine Radioactivity Studies. Final Report, 1 January 1968–14 February 1972. Georgescu, I. (International Atomic Energy Agency, Vienna (Austria)). Nov 1972. 4p. INIS.

The results of studies on the iron-manganese nodules found in the Romanian shelf of the Black Sea are reported. These black-brown nodules, 1-3 cm in size, were collected from a depth of 90 m and studied by Moessbauer spectroscopy between 77 and 295°K. Thermogravimetric and phase transformation data is also given. The Moessbauer spectra obtained, display the characteristic quadrupolar splitting of trivalent iron. (auth)

3161 (LA-UR-74-623) CONTAMINATION LIMITS FOR REAL AND PERSONAL PROPERTY. Healy, J. W.; Smith, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 10p. (CONF-740406-11). Dep. NTIS $4.00.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Recommendations are presented for interim standards for the maximum permissible concentration of Pu in soil. The effects of man's activities and meteorological conditions on resuspension from the top one mm depth layer of soils are considered. (CH)

3162 DETERMINATION OF THE ISOTOPE-EXCHANGEABLE PHOSPHORUS IN CERTAIN SOIL TYPES. Ivanov, P.; Stanev, A. Pochvozn. Agrokhim.; 7: No. 4, 13-24(1972). (In Bulgarian).

A study has been carried out to find a more accurate experimental procedure in measuring the isotope-exchangeable P. The E-values by varying the interaction time (from 1 to 240 hours) and the amount of the carrier (from 0.1 to 20 mg of P_2O_5/100 g of soil) have been determined in 16 soil types, which constitute the most widespread chernozem and grey forest soil types in North Bulgaria. The values obtained are compared with P uptake by plants in a glasshouse experiment (ryegrass at 45-day growth period) by correlation and regression analyses. The absolute E-value with the same soil type varies markedly not only by modifying the time of exchange, but also by varying the amount of the carrier. Highest values have been obtained at a minimum amount of the carrier: these values decrease markedly with the increase in the amount of the carrier up to 5 to 10 mg; beyond that limit the effect of the carrier is less strongly expressed and occurs in different trend. The best correlation of phosphorus uptake by plants is obtained at the one-hour period of isotope-exchange in determining the E-value. In this case the amount of the carrier is not of a particular importance. By extending the period of interaction of the ^{32}P and the soil, the correlation between the E-values obtained and the uptake by plants decreases, which is more markedly expressed in the case of grey forest soils as compared with the chernozem types. In that case best results are observed for the isotope-exchangeable P if 5 to 10 mg of P_2O_5/100 g of soil as carrier are used. (auth)

Water

3163 (CONF-740406-5) GROUNDWATER TRANSPORT OF RADIONUCLIDES FROM BURIED WASTE: A CASE STUDY AT OAK RIDGE NATIONAL LABORATORY. Duguid, J. O. (Oak Ridge National Lab., Tenn. (USA)). 1974. 24p. Dep. NTIS $4.25.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Five burial grounds have been used in past operations at ORNL. Current burial ground studies show that burial ground 4 is the major contributor of ^{90}Sr to the groundwater within the burial ground complex. Higher concentrations of ^{90}Sr in the groundwater in the watershed in which burial ground 4 is located increase the amount of ^{90}Sr in White Oak Creek, which drains the area and flows into the Clinch River. After burial of low-level waste in burial ground 4 was discontinued in 1959, the elevation of the water table in that burial ground increased. Then the area was used for disposal of uncontaminated fill. The fill increased the surface elevation and also increased the permeability of the surface soil. This raised the groundwater table because of the change in topography and the increased infiltration rate. The resulting saturated conditions and likely changes in soil chemistry increased the leaching rate of the buried waste. The increased leaching rate causes 1 to 2 curies of ^{90}Sr to be transported from burial ground 4 each year. (auth)

3164 (SFL-A-19) NATURAL RADIOACTIVITY OF GROUND WATER IN THE HELSINKI AREA. Kahlos, H.; Asikainen, M. (Institute of Radiation Physics, Helsinki (Finland)). Nov 1973. 59p. Dep. NTIS (US Sales Only) $6.00.

A study of the natural radioactivity in ground water was performed in the Helsinki area. The survey indicated highly radioactive water in some bored wells. Nuclides originating from the uranium and thorium series were investigated, and ^{222}Rn, ^{226}Ra, ^{228}Ra and U_{nat} were detected. The concentrations of the nuclides were determined with radiochemical analyses or with gamma spectrometric measurements. The methods of analysis are described, locations and use of the wells are presented, and the results are reported in detail. The influence of the concentrations on the long term users was considered from the point of view of radiation protection. Natural radioactivity of ground water in the Helsinki area was also compared with the results presented in the literature. (auth)

3165 DISTRIBUTION OF ^{228}Ra IN THE WORLD OCEAN. Kaufman, A.; Trier, R.M.; Broecker, W.S. (Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York 10964); Feely, H.W. J. Geophys. Res. 78: No. 36, 8827-8848 (20 Dec 1973).

Surface and subsurface samples of seawater collected in the Atlantic, Arctic, Indian, Pacific, and Antarctic oceans have been analyzed for ^{228}Ra. The results agree with those obtained by Moore (1969) and show that near-shore surface waters normally contain much higher ^{228}Ra concentrations than surface waters collected in the open sea, that surface waters normally contain much higher ^{228}Ra concentrations than intermediate and deep waters, but that near-bottom waters are somewhat enriched in ^{228}Ra. Surface waters of the North Atlantic and Indian oceans contain significantly higher concentrations of ^{228}Ra than those of the Pacific and Antarctic oceans. Vertical profiles of ^{228}Ra activities have been used to calculate values of the constant for vertical eddy diffusion Kz of about 0.3 cm^2/sec in the Arctic Ocean in the zone between the cold water mass that originates in the Bering Sea and the underlying warmer but more saline water mass that originates in the Atlantic. Values of Kz of about 0.5 to about 7 cm^2/sec have been calculated for the upper 200 meters of the Atlantic and Pacific and of about 5-100 cm^2/sec for the bottom water masses of the Atlantic and Pacific. The meridional gradient of ^{228}Ra in the surface waters south of Australia and New Zealand has been used to calculate a value of the constant for horizontal eddy diffusion perpendicular to the wind-driven circulation K_y of about 10^7-10^8 cm^2/sec. (auth)

3166 VEGETABLE BIOINDICATORS OF THE CONTAMINATION OF A WATER FLOW BY THE WASTES FROM A PRESSURIZED WATER NUCLEAR POWER PLANT. Kirchmann, R. (CEN, Mol, Belg.); Lambinon, J. Bull. Soc. Roy. Bot. Belg.; 106: 187-201(1973). (In French).

In the outline of a general program of environmental surveillance around nuclear power stations, several aquatic and ripicolous plants were checked as possible bioindicators of water contamination and of its variations in course of time. The comparison of different plant species emphasizes the difficulties of the use of helophytes; it leads to the choice of aquatic mosses, particularly Cinclidotus danubicus, as biological indicators. Response of this species at a point situated at about 15 km downstream of the Ardennes Nuclear Power Station was analyzed during a period longer than three years. The contamination levels of this indicator at some points of the stream of the river Meuse were compared at an interval of two years; results are discussed, specially in connection with the activity levels of the releases. (auth)

3167 ALPHA AND BETA NATURAL CONTAMINATION LEVELS REACHED BY REPRESENTATIVE GROUPS OF THE MEDITERRANEAN BIOTA. Alvarez Ramis, C. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 86, 447-456(1973). (In Spanish).

The natural contamination of α and β emitters was studied in biological groups and in water and sediments in the Spanish provinces of Tarragona, Valencia, Murcia, and Almeria. The values determined for water and for organisms and the concentration factor of the organisms as a function of the water are given for both α and β emitters. In some organisms and especially for skeletons values are given for the ^{90}Sr levels. The levels of ^{137}Cs are determined in the soft tissues. Uranium is determined in a significant group of representative organisms of the biota. In all cases the value reached in each province for each group and the average are given. (tr-auth)

3168 FALLOUT ^{240}Pu AND ^{239}Pu IN ATLANTIC MARINE SAMPLES. Noshkin, V. E. Jr.; Gastrousis, C. (Woods Hole Oceanographic Institution, MA). Earth Planet. Sci. Lett.; 22: No. 2, 111-117(May 1974).

Mass spectrometric analyses of low levels of global fallout plutonium separated from Atlantic marine samples have differentiated fallout ^{239}Pu and ^{240}Pu in aquatic samples for the first time. The results show no single characteristic $^{240}Pu/^{239}Pu$ ratio in marine samples; the observed range is from 0.11 to 0.24 on an atom basis. There are indications that differences exist in the chemical or physical form of plutonium from atmospheric fallout in Atlantic surface water and that selective concentration in surface organisms is occurring. No single $^{240}Pu/^{239}Pu$ value is found in pelagic sediments collected from different depths and locations. Discounting sources other than fallout, results show that the plutonium deposited at any given time since atmospheric testing began may have carried a unique $^{240}Pu/^{239}Pu$ tag. This label may be extremely useful to trace fallout plutonium through biogeochemical cycles. (auth)

3169 PROSPECTING FOR UNDERGROUND WATER BY THE SURFACE DETECTION OF NATURAL RADIOACTIVITY. Ochiai, T. (Agricultural Engineering Research Station, Hiratsuka, Japan). Chigaku Zasshi; 81: No. 5, 307-318(Oct 1972). (In Japanese).

No effective method of surveying the fissure ground water in the base rock has hitherto been found. Study since 1950 of surveying the fissure ground water by measuring the natural radioactivity (gamma-ray) has established the prospecting method. This method may be applicable not only to the development and utilization of natural ground water, but also to the surveying of artificially recharged ground water. This method of ground water prospecting has been successful in detecting some large fissure water zones in thirty water-short areas in Japan. In these areas where the strong radioactivities were detected deep wells were drilled, from which several hundreds to four thousands cubic meters per day of water were obtained. The radioactive detection of these ground waters was done using tritium. (auth)

3170 CONTENT OF SOME NATURAL RADIOACTIVE ELEMENTS, ESPECIALLY ^{222}Rn IN SOME POTABLE WATERS IN SWEDEN. Snihs, J. O. (Statens Straalskyddsinstitut, Stockholm). Nord. Hydrol.; 4: No. 4, 256-274(1973).

The content of ^{222}Rn in drinking water from 118 wells in southeastern Sweden has been measured. The radiation dose from ^{222}Rn is completely dominant in comparison with the dose from other nuclides examined. Only bored wells and especially those in granite bedrock have contents exceeding 20 nCi per liter. Dug wells usually have contents less than 2 nCi per liter. (auth)

3171 ^{226}Ra AND ^{224}Ra(ThX) CONTENTS IN HOT SPRING WATER. Sugihara, T. (Yamanashi Univ., Kofu, Japan). Yamanashi Daigaku Kyoikugakubu Kenkyu Hokoku; No. 21, 182-189(Mar 1971).

Contents of ^{226}Ra and ^{224}Ra(ThX) were studied at Masutomi spa, Yamanashi Prefecture. Samples were collected from 18 springs. Highest ^{226}Ra content was found in the sample collected at Tsuganero No. 1 spring in August, 1947, the radioactivity being 32×10^{-12} Ci/l. Positive correlation was found between concentrations of ^{226}Ra and Cl^-. Consequently, ^{226}Ra comes from deep places in ground with Cl^-. Positive correlation was found in concentrations of ^{224}Ra and Cl^-. Positive correlation was also found between temperature of the springs and the concentrations of ^{224}Ra and ^{226}Ra. Negative correlation was found between ^{226}Ra/Cl ratio and pH. It was noticed that the ^{226}Ra content in unit Cl^- concentration increased with decrease of pH. Values of ^{226}Ra/Cl were $0.08 - 34.9 \times 10^{-12}$. Values of ^{224}Ra/^{226}Ra were from 0.7 to 1.0. Positive correlation was found between the value of ^{224}Ra/^{226}Ra and rate of spout of hot water. (JA)

Ecosystems and Food Cycles

Refer also to abstracts 3685 and 3704.

3172 (CEA-R-4571) EXPERIMENTAL STUDY OF $110m_{Ag}$ CONCENTRATION IN DIFFERENT MARINE ORGANISMS. Pouvreau, B.; Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Apr 1974. 17p. (In French). Dep. NTIS (US Sales Only) $4.00.

Experiments were carried out to determine the values of the concentration factors for $110m_{Ag}$ in some coastal marine organisms, some of which are used in human diet. Results are usually similar to those measured in situ for the stable element. A heavy concentration of this isotope was noticed in molluscs, especially in oysters. (FR)

3173 (CONF-730996-(Absts.)) ALL-UNION SYMPOSIUM ON THEORETICAL AND PRACTICAL ASPECTS OF THE EFFECTS OF SMALL DOSES OF IONIZING RADIATION, Syktyvkar, USSR, September 4-6, 1973. Kudritskii, Yu. K. (ed.). (AN SSSR, Syktyvkar. Inst. Biologii). 1973. 207p. (In Russian).

Abstracts are included of the 159 papers presented at the All-Union Symposium. The topics discussed were the biological effects of small doses of ionizing radiations on organisms, radioecological aspects of the re-distribution and migration of radioactive elements, and methods of investigation. (JSR)

3174 (COO-2308-1) AVIAN RADIOECOLOGY ON A NUCLEAR POWER STATION SITE. Technical Progress Report, 1 July 1973-30 June 1974. Levy, C. K. (Manomet Bird Observatory, Mass. (USA)). 1974. 32p. Dep. NTIS $4.75.

Activities during the period from July 1973 to July 1974 in a program for radiation monitoring of bird populations in the vicinity of the Pilgrim Nuclear Power Station in Massachusetts are reported. A number of significant changes occurred in the operation of the radioecology project as compared to its earlier operations under the sponsorship of the Boston Edison Company. The new, more sensitive whole-body counting chamber was designed, constructed and installed. Sampling intensity was increased and the trapping sites were carefully re-studied to ensure their continued validity as specimen sources. All aspects of the program were assessed to refine and codify techniques and procedures to ensure long-term effectiveness. Research data for the reporting period include the quantification of ^{137}Cs body burdens demonstrating unique population groupings dependent on geographic location over a relatively small area. There was also the probable detection of ^{131}I on three separate occasions possibly related to a reactor shutdown and accompanying pressure-vessel opening. Complete descriptions are presented of the new counting chamber, the field activities, and the radioecological measurement data for the reporting period. (auth)

3175 (EPA-520-4-73-2) ENVIRONMENTAL RADIATION DOSE COMMITMENT: AN APPLICATION TO THE NUCLEAR POWER INDUSTRY. (Environmental Protection Agency, Washington, D. C. (USA). Office of Radiation Programs). Feb 1974. 88p.

The concept of environmental radiation dose commitment was developed and illustrated by application to projected releases of selected radionuclides from the nuclear power industry over the next fifty years. The concept encompasses the total projected radiation dose to populations committed by the irreversible release of long-lived radionuclides to the environment, and forms a basis for estimating the total potential consequences on public health of such environmental releases. Because of the difficulty of making projections of radionuclide transport on the basis of present knowledge, these potential consequences have been calculated only for the first one hundred-year period following release. The particular radionuclides considered are tritium, ^{85}Kr, ^{129}I, and the actinides. (auth)

3176 (INIS-mf-887-1, pp 37-45) CONTROL OF RADIOACTIVE CONTAMINATION OF FOOD IN HUNGARY. Kovacs, J.; Nedelkovits, J. (Fovarosi Elelmiszerellenorzo es Vegyvizsgalo Intezet, Budapest). [nd]. (In Hungarian).

The principles and the procedures are briefly listed of the determination of radioactive contamination of food in Hungary. (INIS)

3177 (INIS-mf-887-2, pp 1-42) CURRENT PROBLEMS OF SOIL AND PLANT RADIOECOLOGY. Liptakova, H.; Sabova, T.; Zaduban, M. (Safarika Univ., Kosice, Czech.). [nd]. (In Russian).

Main tasks of radioecology are listed in the research into the laws of migration of radioactive substances in the biosphere. Results are presented of the research carried out so far, serving as a basis for further experiments in the field of soil and plant radioecology. Experimental efforts dealt with the absorption by plants of ^{90}Sr, ^{91}Y, ^{106}Ru, ^{131}I, ^{137}Cs, and ^{144}Ce from soil. (INIS)

3178 (INIS-mf-887-2, pp 51-63) BEHAVIOR OF ^{90}Sr AND ^{137}Cs IN THE SOIL-FODDER-MILK CHAIN. Csupka, S. (Krajska Hygienicka Stanica, Bratislava). [nd]. (In Slovak).

The contribution of soil to the lucerne and milk contamination was determined by regression analysis. In the years 1964 to 1969 soil contributed to the contamination of lucerne with ^{90}Sr and ^{137}Cs by 28 to 88% and by 5 to 55%, respectively. Lucerne contamination was responsible for 26 to 59% of ^{90}Sr in milk. Cesium-137 tends to form irreversible bonds with soil minerals; it is therefore less possible for plants to sorb the minerals from soil and the contribution of ^{137}Cs to lucerne contamination is thus smaller. A certain relationship of ^{90}Sr and ^{137}Cs in soil and in lucerne is expressed by correlation coefficients. Their low values confirm that a loose relationship exists between the two quantities. The correlation coefficients have the following values: $r = -0.26$ between ^{90}Sr in soil, accessible to plants, and its content in lucerne; $r = 0.50$ between ^{137}Cs in soil, accessible to plants, and its content in lucerne. (INIS)

3179 SOME MARINE RADIOLOGICAL PROBLEMS IN SITUATING NUCLEAR POWER PLANTS BY THE OSLOFJORD. Foeyn, L. (Fiskeridirektoratets Havforskningsinstitutt, Bergen). Fisken Havet; No. 10, 25(Nov 1973).

General aspects of marine ecology and the behavior of radioactive isotopes in a marine environment are followed by consideration of these aspects in the Oslofjord. Concentration factors for the range of elements of interest in algaes, shellfish and fish are given together with fish catch statistics for Oslofjord. Cultivation of mussels is illustrated in a map. A basis for calculation of effluent criteria is presented and the effect of radiation on marine organisms is evaluated. (NO)

Radiometric Techniques

Refer also to abstracts 2573, 3169, and 3411.

3180 (CONF-720724-P2, pp 73-89) REMARKS ON FISSION-TRACK DATING IN DIELECTRIC SOLIDS. Somogyi, G.; Nagy, M. (Inst. of Nuclear Research, Debrecen, Hungary). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The fission track dating method is discussed. Theoretical determination of thermal track-fading and geometrical correction is considered. Experimental determination of track parameters in the correction formulas and the theoretical basis of the Storzer and Wagner method are included. (LK)

3181 (NP-19991) GEOPHYSICAL LOGGING CAPABILITIES AND PROCEDURES FOR BOREHOLES IN NUCLEAR POWER PLANT SITE INVESTIGATIONS. Crosby, J. W. III. (Washington State Univ., Pullman (USA). Research Div.). 12 Oct 1973. 34p.

For FUGRO, Inc., Long Beach, CA.

Geophysical well logging techniques have been widely used in petroleum exploration and development for many years. During the last two decades the introduction of miniaturized geophysical sondes has accelerated the application of these techniques in ground-water and engineering applications. The responses to geophysical interrogation furnish much information on the physical and chemical characteristics of the borehole environment which can be translated readily into hydrological parameters. These capabilities have resulted in the widespread acceptance and application of the borehole methods in ground-water studies. More recently the geophysical techniques have been used successfully in evaluating stratigraphic and structural relationships in both Quaternary unconsolidated sediments and semiconsolidated and consolidated rocks of all ages. In effect, it has been found that stratigraphy can be determined on a micro scale in much the same manner that macro studies have been successfully applied for years in petroleum development. In the future geophysical methods will be increasingly used in engineering applications, and the interpretation of responses will become more precise as additional work is performed in the near-surface, unconsolidated environment. (auth)

3182 ACCURACY OF TREE RING DATING OF BRISTLECONE PINE FOR CALIBRATION OF THE RADIOCARBON TIME SCALE. LaMarche, V.C. Jr.; Harlan, T.P. (Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona 85721). J. Geophys. Res. 78: No. 36, 8849-8858 (20 Dec 1973).

An independently developed tree ring chronology for bristlecone pine in the White Mountains, California, provides a basis for testing the accuracy of dendrochronological calibration of the radiocarbon time scale. Several lines of evidence show that the growth rings in this species are true annual rings. Internal evidence and cross-chronology comparison indicate that there is no error in calendar dates assigned to wood specimens for comparative radiocarbon analysis, at least back to 3535 B.C. (auth)

3183 TOHOKU UNIVERSITY RADIOCARBON MEASUREMENTS. I. Nishimura, K.; Omoto, K.; Koseki, Y. (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., Seventh Ser.; 22: No. 2, 271-274(Dec 1972).

Radiocarbon age measurement carried out at the Carbon Dating Laboratory of Tohoku University is reported. The measurement was performed from April to June 1972. A proportional counter with the actual volume of 2.4 l was used for the measurement. Carbon dioxide at the pressure of from 500 to 800 mm Hg was used as the counting gas. A counting room was a cellar, and the counter is shielded with 20 cm thick iron plates and 2 cm lead, and is surrounded by 23 propane-flow proportional counters for anticoincidence. Background count was 10.61 cpm at 1 atm. NBS filled at 1 atm showed 30.87 cpm. All samples of wood and charcoal were treated chemically, after hand-removal of sand, gravel and other foreign materials. Shell samples were treated in a different way. The bituminous coal sample as dead carbon was coked, and burned in oxygen stream. NBS oxalic acid standard, modern carbon standard material, was treated with $KMnO_4$ in H_2SO_4 solution. The counting gas was purified. Age calculation is based on the Libby half-life of ^{14}C, 5570 ± 30 yr. The samples were obtained from various places in Japan. The geomorphic and geological samples were from Toya, Kudosan and Shiribetsu rivers near Kutchan, Sakaida and Narugo. An archaeological sample was from Shiogama. (JA)

3184 PHYSICS AND THE ENVIRONMENT: POLLUTION STUDIES USING ISOTOPE TECHNIQUES. Dahl, J. B. Fra Fys. Verden; 36: No. 1, 15-19(1974). (In Norwegian).

The use of radioactive isotope tracers, stable isotope tracers, and activation analysis of tracers in environmental studies is described. The special applications considered are the spreading of pollutants from waste fillings, sewage and industrial waste dumps, the infiltration of pollutants in ground water reservoirs, the spreading of pollutants from leaks in urban and industrial sewers, the infiltration of water in urban and industrial sewers, the spreading of pollutants from planned urban and industrial effluent release in recipients, the dilution of tank washings released from tankers at sea and investigation of the functioning of waste treatment plants. (NO)

3185 RADON ESCAPE FROM POTTERY: EFFECT OF WETNESS. Desai, V. S.; Aitken, M. J. (Oxford Univ.). Archaeometry; 16: No. 1, 95-97(Feb 1974).

Radon and subsequent members of the uranium-238 decay chain are responsible for an appreciable fraction of the radiation dosage received by pottery. Consequently in thermoluminescent dating calculations it is necessary to make an estimate of the degree to which this gas was escaping during burial. Direct measurement of the radon accumulated from pottery fragments indicates that wet conditions do not drastically inhibit the escape of radon, contrary to what has usually been assumed in thermoluminescent dating up till now. (auth)

3186 EFFECT OF WEATHERING ON FISSION TRACK DATING. Gleadow, A. J. W.; Lovering, J. F. (Univ. of Melbourne). Earth Planet. Sci. Lett.; 22: No. 2, 163-168(May 1974).

Fission track ages have been determined on sphene, apatite, and zircon separated from fresh and highly weathered rock samples. Sphene and zircon ages are unaffected by even extreme weathering. Apatite from partially weathered granite gives a similarly unaffected age. Badly corroded apatites from a residual clay, however, do show a 17% reduction in apparent age, involving loss of both spontaneous fission tracks and uranium from the crystals. (auth)

3187 CHARACTERISTICS OF POINT ACTIVATION MEASUREMENTS MADE IN BOREHOLES WITH A CONTROLLED NEUTRON SOURCE. Strel'chenko, V. V.; Yakubson, K. I. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 144-145(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 114(Feb 1973). This is a summary of paper No. 649/6814 with full copy held by TIC.

On the basis of calculated and experimental data, the authors analyze the relationship between the the values of activation effects for pulsed and traditional versions of point activation measurements in boreholes as functions of the activation characteristics, the resulting radioactive isotopes, and the regimes of operation of a controlled neutron source. (auth)

3188 NUCLEAR AND ACOUSTIC METHODS FOR ISOLATING PRODUCTIVE STRATA IN CASED WELLS. Karus, E. V.; Shimelevitch, Yu. S.; Petrosyan, L. G. (All-Union Research Inst. of Nuclear Geophysics, and Geochemistry, Moscow). Tr., Vses. Nauch.-Issled. Inst. Yadern.; No. 11, 1-116(1972). (In Russian).

Data are presented on the results of creating and testing out a group of geophysical methods, mainly to investigate cased wells with the purpose of differentiating productive strata. It is shown that by comparing the results of repeated measurements in cased wells it is possible to obtain information on the breakup of the zone near the well in which the water filtrate penetrates during drilling, and on the approach of stratum fluid to the well shaft. From a comparison of the results of repeated measurements it is possible to study the disruption of the cement plug, its salting with mineralized water, and filling of the cracks with gas. In order to study these processes, effective methods must be used—pulse neutron surveying, acoustic surveying and others. In developing the group of methods it was necessary to take into account the varying depth of the studies at which it was necessary to carry out stratum testing of the medium around the well. The complex of methods considered in the study is primarily intended to examine cased wells of older age, and to find collectors lying above the main development stratum. (SJR)

3189 NUCLEAR GEOPHYSICS. Venkatavaradan, V. S. (Tata Inst. of Fundamental Research, Bombay). Izotoptechnika; 17: No. 2, 53-61(Feb 1974).

Methods for humidity determination with neutrons, γ-densitometry, neutron activation, and radioactive dating are discussed. (auth)

3190 NUCLEAR METHODS OF ELEMENT ANALYSIS AND GEOPHYSICAL TESTING. Berzin, A. K.; Blyumentsev, A. M.; Savosin, S. Y.; Sulin, V. V. (All-Union Research Inst. of Nuclear Geophysics, and Geochemistry, Moscow). Tr., Vses. Nauch.-Issled. Inst. Yadern.; No. 13, 1-96(1972). (In Russian).

This book includes material dealing with nuclear techniques and methods of testing ores and minerals for a number of elements. The use of nuclear methods is discussed for studies of samples of ores and minerals in solving various geological and petrographic problems. The development and use of methods of nuclear geophysics are described for well surveying and geophysical testing. (SJR)

Site Surveys

Refer also to abstracts 3106–3110, 3181, and 3201.

3191 (BNWL-1707) TRANSMISSIVITY ITERATIVE PROGRAMS ON THE PDP-9 COMPUTER: A MAN–MACHINE INTERACTIVE SYSTEM. Addison, L. E.; Friedrichs, D. R.; Kipp, K. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 78p. Dep. NTIS $5.45.

A system of computer programs, The Transmissive Iterative Sequence, has been written with the purpose of providing an analytical aid in the simulation of groundwater flow. This man–machine interactive system directly involves the user making decisions in the analysis loop. Because of the limited amount of data available, this analysis loop is highly iterative in nature and its success depends on the ability to rapidly input and output information in a form directly related to the groundwater system being analyzed. The Iterative Sequence provides these analytical capabilities in a self-contained computer package which constitutes a useful tool for modeling a groundwater system. (auth)

3192 (BNWL-1709) COLLECTION AND ANALYSIS OF PUMP TEST DATA FOR TRANSMISSIVITY VALUES. Kipp, K. L.; Mudd, R. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 83p. Dep. NTIS $5.45.

The analysis of the well pump tests performed in 1969 to determine the field measured transmissivity values used in "The Transmissivity Iterative Calculation Routine—Theory and Numerical Implementation," is described. Previously accumulated pump test transmissivity values which were also used as input data are included for completeness and the analytical models employed for pump test analyses are described. A sensitivity study was performed on the pertinent variables and procedures of the pump test analyses. Tables of transmissivity results and the graphs used to obtain them are included. Unfortunately, meaningful values for the storage coefficient were unobtainable. (auth)

3193 (BNWL-SA-4958) FOOD PLANT SELECTION BY THE MIGRATORY GRASSHOPPER (MELANOPLUS SANGUINIPES) WITHIN A CHEATGRASS COMMUNITY. Rogers, L. E.; Uresk, D. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 13p. (CONF-740517-1). Dep. NTIS $4.00.

From Northwest Scientific Association annual meeting; Vancouver, B. C., Canada (9 May 1974).

A dietary analysis was made of a migratory grasshopper population within a cheatgrass (Bromus tectorum) community located on the Arid Land Ecology (ALE) Reserve within the boundaries of the Atomic Energy Commission's Hanford Reservation in southeastern Washington. Microscopic identification of plant fragments taken from the gut of Melanoplus sanguinipes was used to determine food plant selection. (auth)

3194 (NERC-LV-539-28) SOIL SURVEYS OF FIVE PLUTONIUM CONTAMINATED AREAS ON THE TEST RANGE COMPLEX IN NEVADA. Leavitt, V. D. (National Environmental Research Center, Las Vegas, Nev. (USA)). Mar 1974. 84p. Dep. NTIS $5.45.

Soils in five areas located on the Test Range Complex, Nye County, Nevada are described. All of the areas have at one time been sites of above-ground nuclear safety tests. The areas are contaminated with plutonium and are, therefore, the object of investigations regarding the movement of plutonium in the environment. Most of the surface soils in the five areas have a gravelly texture and are typically classified as gravelly sandy loam. The majority of the surveyed land is either flood-plain or alluvial fan with deep soils having well-developed profiles and platy structure. All of the soils are alkaline ranging in pH from 7.0 to 9.0. The vegetation is classified in two general categories, low and high desert shrub. The low desert shrubs are predominantly creosotebush (Larrea divaricata), and white bursage (Franseria dumosa). The high desert shrubs are mostly fourwing saltbush (Atriplex canescens), winterfat (Eurotia lanata), and bud sagebrush (Artemisia spinescens). (auth)

3195 (NP-19992) PRINCIPLES OF MAGNETOSTRATIGRAPHY (PALEOMAGNETIC DATING). Kukla, G. J. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 19 Oct 1973. 28p.

For Fugro, Inc., Long Beach, Calif.

Most sediments, similar to volcanic and metamorphic rocks, contain magnetic minerals which record the timely corresponding local vector of the Earth's magnetic field. While in volcanic rocks and deep sea sediments the remanent magnetization changes only slightly after the layers cooled or settled, the magnetic properties of land based sediments are affected during their often complicated postdepositional histories. Samples mostly show strong normal magnetic overprint which must be removed by progressive demagnetization before the depositional remanence can be evaluated. Sensitive spinner magnetometers are used for this purpose. Once the original polarity of samples is known, it can be correlated with the standard magnetostratigraphic sequence, which has been absolutely dated by the K/Ar method. The last full polarity reversal of the Earth's magnetic field occurred world-wide 0.7 million years ago. This reversal is useful in determining the minimum age of sediments with reversed polarity. Records of this event also exist in sediments of the San Joaquin Valley. (auth)

3196 (WASH-1280) OFFSHORE NUCLEAR POWER SITING WORKSHOP, ROCKVILLE, MARYLAND, OCTOBER 15–16, 1973. (USAEC Division of Biomedical and Environmental Research, Washington, D.C.). 1973. 41p. Dep. NTIS $4.00.

Three papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 3197–3199.

3197 (WASH-1280, pp 1-15) WATER MOTION AND WATER-SEDIMENT INTERACTION. Inman, D.; Swift, D.; Duane, D.; Smith, J.; Gross, G.; Forster, W.; Darneal, B. 1973.

In offshore nuclear power siting workshop.

Problems concerned with water motion and water-sediment interactions that occur over the continental shelf and are thought to be important to environmental considerations of the contemplated offshore power systems, their effluents, and their protective structures are discussed. (LCL)

3198 (WASH-1280, pp 17-28) BIOLOGICAL ASPECTS OF OFFSHORE NUCLEAR POWER PLANTS. Eppley, R.; Yentsch, C.; McHugh, L. 1973.

In offshore nuclear power siting workshop.

Possible environmental biological problems that would be associated with the construction and operation of offshore nuclear power plants are discussed for the purpose of identifying the research studies required to understand these biological problems. General recommendations are made for long- and short-term research projects. (LCL)

3199 (WASH-1280, pp 29-35) OCEANIC ATMOSPHERIC DISPERSION. Csanady, G.; Frenzen, P.; Michael, P.; Slade, D.; Hersch, A.; Manowitz, B. 1973.

In offshore nuclear power siting workshop.

Offshore nuclear power plants will reject thermal and chemical pollutants which will accumulate in the neighborhood of the plant. In order to determine how these accumulations are diffused, research on atmospheric dispersal problems is recommended in the three areas of turbulence and diffusion in the maritime planetary boundary layer, mesoscale circulations, and air-sea mass exchange. (LCL)

Thermal Effluents

Refer also to abstracts 3198, 3199, and 5665.

3200 (CONF-740608-7) TIDAL TRANSIENT FAR-FIELD MODEL FOR OFFSHORE THERMAL DISCHARGES. Erasian, A. H.; Siman-Tov, M. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

A far-field two-dimensional thermal energy transfer model is presented for simulating temperature distributions resulting from the condenser cooling water discharges of offshore power plants in large coastal regions. The vertical variations of the velocity components and thermal stratification effects which usually exist in coastal regions are rigorously incorporated in the model by considering multi-layer flow conditions in the formulation. The mathematical formulation employs the integral forms of the conservation principles for mass and energy in individual, variable-sized discrete elements that span the large coastal region. (auth)

3201 (DP-MS-73-66) TEMPERATURE EFFECTS ON GROWTH AND RESPIRATION RATES OF DOLANIA AMERICANA (Ephemeroptera). Harvey, R. S. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 28p. (CONF-740433-2). Dep. NTIS $4.50.

From 35th annual meeting of the Association of Southeastern Biologists; Savannah, Georgia, USA (18 Apr 1974).

Upper Three Runs Creek is the source of water, substrate, and organisms for the six experimental streams of the Thermal Effects Laboratory, where long-range studies are in progress to determine the effects of nonlethal elevations in water temperature on the

ecology of stream organisms. The Mayfly, Dolania americana, common in the sand substrate of Upper Three Runs Creek is being studied to determine the effects of seasonal changes in temperature on population growth rates, and the effects of slight elevations in water temperature on the respiration rates of maturing males and females. Growth and respiration rates of the population increased with temperature until the 2-year-old nymphs emerged in June and July. Throughout the past year, respiration rates increased with body weight and water temperature. (auth)

3202 (DP-MS-73-67) PERIPHYTON COLONIZATION AND PRODUCTIVITY IN THE REACTOR COOLING RESERVOIR: PAR POND. Tilly, L. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 18p. (CONF-740433-3). Dep. NTIS $4.00.

From 35th annual meeting of the Association of Southeastern Biologists; Savannah, Georgia, USA (18 Apr 1974).

Glass slides with periphyton colonies are being collected at six different locations with varying thermal effluents for determinations of dry-weight standing crop, chlorophyll, species composition, and ^{14}C productivity. Standing crops and productivity differ with proximity to the thermal discharge, and also by season, so that zones of maximum growth shift with time. Periphyton community characteristics are discussed in relation to limnological characteristics of the stations studied. (auth)

3203 (DP-MS-73-69) SOME ASPECTS OF THE EFFECTS OF ELEVATED WATER TEMPERATURE ON THE RAMSHORN SNAIL. Johnson, G. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 13p. (CONF-740433-1). Dep. NTIS $4.00.

From thirty-fifth annual meeting of the Association of Southeastern Biologists; Savannah, Georgia, USA (18 Apr 1974).

The effects of location in relation to a thermal gradient on two abundantly distributed species of ramshorn snails, Helisoma trivolvis and Helisoma anceps, were investigated at a 2500-acre reactor cooling reservoir (Par Pond) on the Savannah River Plant. Observations and results of ongoing experiments related to the thermal tolerance, respiratory rates, distribution and density, life cycles and growth, and behavioral patterns of Helisoma in Par Pond are discussed. (auth)

3204 (ORNL-EIS-74-66) COOLING SYSTEMS: TOWERS, PONDS, AND ONCE-THROUGH COOLING. Combs, Z.; Huber, E. E.; Talmi, B. C. (comps.). (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 127p. Dep. NTIS $9.50.

A bibliography is presented of 406 references on cooling systems. Information is included on cooling lakes and reservoirs, meteorology, environmental effects, economics, design criteria, water supplies, and hydrodynamics. Corporate and individual author indexes and a permuted title index are provided. (LCL)

3205 (ORNL-tr-2758) DISPERSION OF WASTE WATERS FROM THE KONAKOVSKI POWER PLANT AS A FUNCTION OF THE OUTPUT. Butorin, N. V.; Kurdina, T. N. Translated by M. Gerrard from Biol. Vnutr. Vod, Inform. Byull.; No. 14, 61-65(1972). 4p. Dep. NTIS $3.00.

Results are presented of studies performed during the winters of 1967 to 1971 determining the effects of increased coolant flow through the Konakovski Power Plant on the temperature of and the temperature distribution in the reservoir receiving the heated effluent. (LCL)

3206 (ORNL-tr-2764) TEMPERATURE REGIME OF THE IVANKOVO RESERVOIR NEAR THE KONAKOVSKI HYDROELECTRIC POWER STATION. Kurdina, T. N. Translated From Biol. Vnutr. Vod, Inform. Byull.; No. 4, 26-(1969). 5p. Dep. NTIS $4.00.

The first reconnaisance exploration of the Ivankovo water reservoir in the Konakovski power station environs was made in February 1967. It showed that with the volume of the station water discharge, which was around 30 m^3/sec, there was a significant change in the ice-thermal regime of this part of the reservoir. For further studies of this problem, a 1-year cycle of observations of the temperature conditions of this region was made from February 1967 to January 1968. Eleven trips were made—three when ice was present and eight under ice-free conditions. Data from these observations confirmed that heated water discharged from the Konakovski power station had a significant effect on the ice-thermal conditions of the water reservoir region adjoining the station. In the winter, water in the river part below the reservoir increased in temperature from 1.5 to 2.0°C with a coolant flow of 30 m^3/s and from 2.5 to 3.0°C with a flow of 50 m^3/s. The effects of the temperature changes on the aquatic ecosystem of the region are being studied. (LCL)

3207 PRESENT COOLING WATER SITUATION IN THE FEDERAL REPUBLIC OF GERMANY. Krolewski, H. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). pp 3-10 of Probleme des Industriellen Kuehlwassers. Giesen, K. (ed.). Essen; Vulkan-Verlag (1972). (In German).

From problems on industrial cooling water; Essen, Germany (21 Feb 1972).

Following a general introduction into the problems of waste heat and cooling processes, the state of power station techniques is looked at and the water economy aspects are discussed. (GE)

3208 MATHEMATICAL SIMULATION OF HEAT EXCHANGE PHENOMENONS IN WATERS SHOWN BY THE EXAMPLE OF THE THERMAL LOAD PLANTS OF THE RHINE RIVER. Flinspach, D. (Innenministerium Baden-Wuerttemberg, Stuttgart). pp 11-15 of Probleme des Industriellen Kuehlwassers. Giessen, K. (ed.). Essen; Vulkan-Verlag (1972). (In German).

From problems on industrial cooling water; Essen, Germany (21 Feb 1972).

Following a short description of an estimate of the Rhine's thermal behavior with a simulation process and its result (thermal load plan), the most important contributions to an exclusive discussion are given. (GE)

3209 INDUSTRIAL COOLING WATER. Haeringer, G. (Ministerium fuer Ernaehrung, Landwirtshaft und Forsten des Landes Nordheim-Westfalen, Dusseldorf). pp 15-21 of Probleme des Industriellen Kuehlwassers. Giessen, K. (ed.). Essen; Vulkan-Verlag (1972). (In German).

From problems on industrial cooling water; Essen, Germany (21 Feb 1972).

Past and current efforts made to keep the Rhine clean and to remove the heat released from power stations are described. The thermal load plan of the Rhine is discussed as well as its effect on future planning. Furthermore, the contributions to an exclusive discussion are given. (GE)

3210 POSSIBILITIES OF SUPPLYING ADDITIONAL COOLING TOWER WATER BY MEANS OF ARTIFICIAL FEDERAL WATERWAYS. Pietzner, W. (Wasser- und Schiffahrtsdirektion, Muenster, Ger.). pp 25-40 of Probleme des Industriellen Kuehlwassers. Giesen, K. (ed.). Essen; Vulkan-Verlag (1972). (In German.

From problems on industrial cooling water; Essen, Germany (21 Feb 1972).

Manifold-purpose navigable channels, present and future expected water uses on federal waterways, as well as the West German channel network, are reviewed. The most important channels in water requirement and supply are particularly thoroughly dealt with. (GE)

3211 ENERGY TECHNOLOGY AS A MEANS OF SHAPING THE ENVIRONMENT AND AS A FACTOR OF STRESS ON THE ENVIRONMENT. Schaefer, H. (Technische Univ., Munich). Kerntechnik; 15: No. 12, 570-573(Dec 1973). (In German).

Energy technology arose from endeavors to make human activities less dependent on environmental conditions. By now, energy technology has become indispensable for supplying the needs of mankind and for getting rid of its wastes. On the other hand, energy consumption is increasing exponentially owing to the growth of population and to rising living standards, and has reached a level where it exerts unfavorable effects on the ecology. In the long term, the limit to this growth of energy consumption will be set not so much by the emission of solid and gaseous atmospheric pollutants as by the thermal load due to the conversion and use of energy. Considered on a global scale, a reduction in the total energy consumption growth rates seems hardly likely in the foreseeable future. A possibility of limiting the ecological load does nevertheless exist, by reducing the specific energy consumption in various areas of energy utilization. In this field there still exist diverse technical possibilities for controlling the increase in primary energy consumption. (auth)

Chemical Effluents

Refer also to abstracts 3139, 3140, 3198, 3199, 3209, 5695, and 5730.

3212 (LA-UR-74-589) TREATMENT OF TOXIC CHEMICAL WASTES AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Buchholz, J. R.; Christenson, C. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 11p. (CONF-740406-8). Dep. NTIS $4.00.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

A review of the methods of treating of variety of toxic liquid wastes routinely handled at LASL will be presented. These wastes include heavy metal cyanide solutions, metal-containing acid pickling baths, fluoride cleaning solutions, and chromic acid. The goal of the treatment is to render the toxic elements of the waste insoluble or nontoxic so they can be buried on-site with a minimum of risk to the environment. (auth)

3213 ENVIRONMENTAL PROBLEMS CAUSED BY COOLING TOWER OPERATION. Yield and Release of Dissolved and Undissolved Substances. Resch, G.; Burgmann, F. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). pp 47-49 of Probleme des Industriellen Kuehlwassers. Giesen, K. (ed.). Essen; Vulkan-Verlag (1972). (In German).

A cooling water analysis performed to record dissolved and undissolved substances is reported. (GE)

3214 INSTRUMENTAL ANALYSIS IN ENVIRONMENTAL CHEMISTRY: GAS PHASE DETECTION SYSTEMS. Stedman, D. H.; Meyers, P. A. (Univ. of Michigan, Ann Arbor). Bioscience; 24: No. 5, 277-282(May 1974).

Various instrumental techniques that are particularly suitable to environmental monitoring are discussed. The methods are: atomic absorption spectrophotometry, uv-visible analysis, ir analysis, microwave spectrometry, total organic carbon and elemental analysis, gas chromatography, and mass spectrometry. Included are a list of general books about analytical techniques and a list of analytical journals that describe recent advances and specialized applications. (40 references) (JGB)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 3483.

3215 BETAVOLTAIC ENERGY CONVERSION. Olsen, L. C. (Donald W. Douglas Labs., Richland, WA). Energy Convers.; 13: No. 4, 117-127(Oct 1973).

The utilization of betavoltaic energy conversion to make power sources producing power in the microwatt to milliwatt range is discussed. Trade-offs involved in selecting the beta source and semiconductive junction device are considered. Emphasis is placed on simultaneous consideration of radioisotope half-life, average beta particle energy, radiation effects and junction device properties. Presently, the best approach for fabricating betavoltaic power sources incorporates ^{147}Pm beta sources coupled to silicon devices. Current-voltage characteristics of silicon n^+p devices coupled to ^{147}Pm beta sources are presented. Results are given which indicate that silicon cells can be coupled to bidirectional ^{147}Pm sources to produce power with an overall efficiency of approximately 4.6%. Experimental data are discussed which show that radiation effects in the Si/^{147}Pm system are minimal. Characteristics of a large number of prototype batteries having output power of 50, 200 and 400 μW are also discussed. Possible applications of these batteries include powering a heart pacemaker for seven to ten years. (auth)

General Detectors and Monitors

Refer also to abstracts 2571, 2597, 3155, 3433, 3482, 3499, 3500, 3610, 4080, 5220, 5410, 5433, 5461, 5701, and 5733.

3216 (BARC/I-49) CONTINUOUS AIR MONITOR: FIXED FILTER TYPE. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 11p. INIS.

A Model AM-853 continuous air-monitor having a fixed filter type β-γ monitor for particulate airborne radioactivity is described. The instrument consists of the pump assembly, suction head, detector, high voltage unit, count rate meter, and alarm unit housed in a single rack mounted on castor wheels. A special design of the sampling probe makes the instrument suitable for remote sampling and for its use in areas of high contamination potential. Detailed specifications and operating instructions are given. (INIS)

3217 (BARC/I-54) LITHIUM-DRIFTED GERMANIUM DETECTOR: SETTING UP AND APPLICATIONS. Samuel, J. K.; Mathews, C. K.; Rengan, K.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 8p. INIS.

An account of the lithium-drifted germanium detector set-up in the Radiochemistry Division of the Bhabha Atomic Research Center, Bombay is reported. The characteristics and some of the applications for the Ge(Li) set-up are examined. The detector is a planar type with 4 cm^2 area and 5 mm depletion depth. To obtain the optimum resolution possible with the Ge(Li) detector, a low-noise electronics system is used. The full-energy peak efficiencies obtained with this detector for various gamma-ray energies are shown. As a part of a program of studying fission yields of actinides, the mass yields in the thermal neutron-induced fission of ^{239}Pu have been determined using the Ge(Li) detector. The fission yields were determined by comparison with the yields in the fission of ^{235}U. The recoil range in the thermal neutron induced fission of ^{233}U and ^{239}Pu is determined by using this detector. The detector is also used for studying zirconium and niobium adsorption of MnO_2. (INIS)

3218 (BARC/I-69) MONITOR FOR PLUTONIUM-IN-AIR. Chugh, P. K. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 6p. INIS.

A plutonium-in-air monitor using a solid state detector and millipore filter paper is described. The silicon surface barrier detector is used for detecting ^{239}Pu activity in the presence of natural activity whereas the millipore filter paper is used to reduce the error caused by degradation of alpha energy due to self-adsorption in the filter paper. The monitor has been tested with different sources for a particular setting and the efficiency of the instrument is found to be 27.5% for ^{239}Pu activity in the presence of natural activity whereas the millipore filter paper is used to reduce the error caused by degradation of alpha energy due to self-adsorption in the filter paper. The monitor has been tested with different sources for a particular setting and the efficiency of the instrument is found to be 27.5% for ^{239}Pu while the channel efficiency is found to be 9.8%. The studies also indicate that the instruments are sensitive to 1 MPC for eight hours with a suction rate of 30 to 35 l/min. (INIS)

3219 (BARC/I-135, pp 69-76) FISSION FRAGMENT ANGULAR DISTRIBUTIONS. Iyer, R. H.; Sagu, M. L. (Bhabha Atomic Research Centre, Bombay). 1971.

A novel experimental set-up using lexan track detectors developed for simultaneous measurement of angular distributions of fragments from five independently fissioning nuclei at a time is described. Neutron beams are obtained from the reaction D(t,n)^{4}He. The results of testing the set-up for measurement of angular distributions of fragments from thermal fission of ^{235}U and ^{239}Pu are presented. (5 figures) (INIS)

3220 (BARC/I-260) BF_3 NEUTRON WELL COUNTER. Janardhan, S.; Pillai, P. M. B.; Swaminathan, N.; Khimani, F. H. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

A BF_3 well counter was fabricated for measurement of neutron output from weak sources like plutonium or uranium compounds. Multiple BF_3 neutron counters embedded in a hollow cylindrical block of paraffin were used to improve geometry and efficiency of detection. The counter moderator assembly provides a well of dimension 22 cm dia. × 41 cm height. Samples like PuO_2 pellets, PuO_2 fuel pins or bulk oxide powder could be mounted in the well so that the emitted neutrons are detected radially by the BF_3 counters whose combined output after suitable amplification is displayed on a scalar system. The BF_3 counters used are of length 30.5 cm and diameter 1.6 cm and were selected from a lot so as to have the same plateau. The array was embedded in a paraffin shell of annulus width 8.5 cm and height 41 cm and the multiple detection system provided an efficiency of ≈1% for (α,n) and spontaneous fission sources. The response of the counter for (α,n) and spontaneous fission spectra was identical and compared well in performance with the annular counter earlier developed in the Health Physics Division of the Bhabha Atomic Research Center, Bombay. The counter is of wide application in nuclear safeguards work and nondestructive assay based on neutron counting of samples. (auth)

3221 (CEA-Bib-209) BIBLIOGRAPHIC STUDY ON THE WINDOWLESS CONTINUOUS CHANNEL ELECTRON MULTIPLIERS, RESEARCH AND DEVELOPMENT. Bornand, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). May 1974. 52p. (In French and English). Dep. NTIS (US Sales Only) $5.75.

In the first part of this study, a bibliographical synthesis is given of research and development carried out up until 1966 in the field of continuous dynode electron multipliers as well as the corresponding applications. The second part covers the 1967 through 1973 period (1st semester) : 159 references are given of articles and original scientific reports together with their abstracts and indexes (subject-matter, author, and laboratory indexes including cited documents and periodicals). The three principal types of window-less continuous dynode and channel electron multiplier are divided into four categories to facilitate the subject-matter classification: parallel-plate electron multiplier functioning with a magnetic field (Magnetic Electron Multipliers); parallel-plate electron multipliers functioning without a magnetic field (Parallel-Plate Channel Multipliers); single-channel multipliers (straight, curved, spiral or helical tubes) (Channel Electron Multipliers); compact array of channel electron multipliers or microchannels plates (Microchannel-Plate Electron Multipliers or Channel-Plate Electron Multipliers). The Brevatome Documentation Service provided 33 French patent references which are presented in an appendix. (auth)

3222 (CONF-720724-P1) PROCEEDINGS OF THE 8th INTERNATIONAL CONFERENCE ON NUCLEAR PHOTOGRAPHY AND SOLID STATE TRACK DETECTORS, BUCHAREST, Romania; July 10–15, 1972. Volume I. Nicolae, M. (ed.). (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 657p. (In Several Languages).

Separate abstracts were prepared for the 50 papers presented. (WHK)

For abstracts of individual papers see: 3223–3258, 3328, 3329, 3483, 3508, 3573, 3574, 4016, 4017, 4120–4123, 4918, and 5212.

3223 (CONF-720724-P1, pp 1-22) MODELLING OF THE EXPERIMENT FOR DETERMINING THE HEAVY ION CHARGE. Bogomolov, K. S. (State Scientific-Research and Planning Inst. of the Chemical-Photography Industry, Moscow). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The rational use of nuclear emulsions for charge determination of cosmic ray nuclei is investigated. The method suggested for the determination of nuclear charges from ^{26}Fe up to transuranium nuclei is based on the use of a stack of photographic layers of different sensitivities so that the charge of each nucleus is verified in at least three emulsions. The accurate charge measurement can be carried out only in a limited range of optical densities of the particle tracks. The measurements are performed in an "ideal diffuse" light, since the densities measured in direct light might be in a nonlinear relationship to the true densities, owing to the light absorption (but not to its diffusion). The conditions for linearity of the detector (LD emulsion) are: a) compact development and b) (practical) absence of two or more collisions of the delta electrons in the emulsion microcrystals. The multiplicity of penetration of delta electrons in the microcrystals has been calculated. A mathematical model of the experimental conditions of charge measurement and transuranian nuclei identification in cosmic rays has been deduced, using an optimum stack of photographic materials. The theoretical curves of the dependence of the radial distribution of nuclear tracks on Z in the range 26 to 104 have been computed for five photographic materials. New photometric criteria are suggested for the optimum comparison of track pairs (reference one and one or two of the investigated ones) in terms of the range of Z values and of densities measured on the track segments compared. The dependence of the criterion "track width" on sensitivity and other parameters of the photographic materials in the track has been determined. (auth)

3224 (CONF-720724-P1, pp 23-33) SOME REMARKS ON THE FORMATION AND DEVELOPMENT OF PARTICLE TRACKS IN PLASTICS. Paretzke, H. G. (Institut fuer Strahlenschutz, Neuherberg, Ger.). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Track formation (analysis of the chain of events and the track structure model) and track development (threshold and detection limit and track etch rate) are discussed. (WHK)

3225 (CONF-720724-P1, pp 47-61) APPLICATION OF THE TRACK FORMATION THEORY BY KATZ ET AL. TO NUCLEAR TRACK PHOTOMETRY AT ION VELOCITIES ABOVE 0.3 c. Mathiesen, O. (Univ. of Lund, Sweden). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A study to determine if the track formation theory of Katz et al. could be used to predict the response of the nuclear emulsion detector and photometer readout system to ions of different Z and β. The transmittance of light is calculated from the theory and the results are compared with the corresponding observed quantity obtained from studies of cosmic ray nuclei with known values of Z and β. It was found that the track formation theory by Katz et al., after addition of a parameter specific to the method of observation, is capable of a faithful description of transmission profiles. (WHK)

3226 (CONF-720724-P1, pp 62-72) WIDTH OF HEAVY ION TRACKS IN NUCLEAR EMULSIONS: A STUDY OF THE ENERGY DOSE CONCEPT FOR ION VELOCITIES β LESS THAN OR EQUAL TO 0.3. Rosander, R.; Jacobsson, L. (Univ. of Lund, Sweden). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Results from an experimental test of the track formation theory by Katz et al. are presented. Track widths of heavy ions in nuclear emulsions have been determined by measuring light absorption profiles of the tracks using a photometer with a narrow slit moving perpendicularly across the track. The tracks are produced by primary cosmic ray particles with the nuclear charges in the interval $6 \leq Z \leq 26$. Two types of emulsion with different sensitivities were investigated. The experimental track widths are compared with calculations of the spatial distribution of the ionization energy delivered by a heavy ion passing through a medium. The measured track widths at half the profile height in the Ilford K2 emulsion are quite well described by the theory. The track widths in the Ilford G5 emulsion agreed fairly well with the theory when measured at $^5/_6$ of the height. (WHK)

3227 (CONF-720724-P1, pp 80-87) RELATIVISTIC INCREASE OF IONIZATION IN TRACK DETECTORS. Chechin, V. A.; Kotenko, L. P.; Merson, G. I.; Ermilova, V. S. (Lebedev Inst. of Physics, Moscow). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

An approach to bring the theory into agreement with experimental data concerning the track density of singly charged relativistic particles in various track detectors is briefly discussed. Heavy liquid bubble chambers, gas detectors of primary ionization, gas detectors of total ionization, and nuclear emulsions are considered. (WHK)

3228 (CONF-720724-P1, pp 88-94) LUMINESCENCE OF NUCLEAR EMULSIONS EXCITED BY α- AND β-RADIATION. Belous, V. M.; Kartuzhanski, A. L.; Kehva, T. E.; Plachenov, B T.; Shur, L. I. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The luminescence emission spectra and the temperature dependence of quenching for type R and type A2 nuclear emulsions and for pressed tablets of gelatine-free AgBr(I) powders excited by α and β particles were studied. Luminescence curves obtained by sample cooling from room temperature to liquid nitrogen temperature are presented, and also thermal glow curves from heating the sample at a constant rate from 77 up to 330°K are presented. (WHK)

3229 (CONF-720724-P1, pp 95-100) ROLE OF IODIDE IONS IN PHOTOGRAPHIC PROCESS INTO SINGLE CRYSTALS OF SILVER BROMIDE. Sanz Santacruz, L. F. (Laboratorio de Fisica del Estado Solido, Valladolid, Spain); de Cunha, S. F.; Saja, J. A. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

It is attempted to verify the action of the iodide ion in annealed single crystals of silver halide. Life-time of photoliberated electrons in AgBr and AgVrI crystals were directly measured by means of photoconductivity techniques (at 80°K). The values obtained indicate that electrons are necessarily captured by traps situated at 0.75 to 0.77 eV below the botton of the conduction band mainly proceeding from structural ionized defects created by the I^-. This makes it necessary to reconsider some points of the Mitchell's theory of latent image formation. (auth)

3230 (CONF-720724-P1, pp 101-109) INVESTIGATION OF FINE-GRAIN EMULSION SENSITIZATION WITH AMINES AND SOME OTHER ORGANIC COMPOUNDS. Belous, V. M.; Kartuzhanski, A. L.; Martysh, G. G.; Shur, L. I. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

An investigation was carried out of the effect of amines and some other organic substances on both the sensitivity of fine-grain emulsions (including that of nuclear emulsions) and the luminescence of these emulsions. The investigation proved that certain amines considerably increase the sensitivity of fine-grain emulsions and showed that the effectivity of these amines is adequately correlated with their effect on the intensity ratio of orange and green bands of low-temperature emulsion photoluminescence. Other luminescence characteristics and in particular the phosphorescence kinetics also can give some information on the expected behavior of these or other substances in emulsion; this is the case for instance for organic compounds belonging to couplers for color development. (auth)

3231 (CONF-720724-P1, pp 110-116) STUDY OF THE LATENT IMAGE WITH THE AID OF ELECTRIC FIELDS. Labau, V. (Inst. of Atomic Physics, Bucharest). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The action of pulsed electric fields was used to study some properties of latent corpuscular images. The energy depth of the latent image centers, the number of the silver atoms that constitute these centers, their absolute dimensions, and other characteristics were determined. (auth)

3232 (CONF-720724-P1, pp 118-123) SOME CHANGES OF THE PARTICLE TRACK PARAMETERS IN NUCLEAR PHOTOEMULSION UNDER THE ACTION OF PULSED ELECTRIC FIELD (PEF). Akopova, A. B.; Kartuzshanskii, A. L.; Magradze, I. V.; Melkumian, L. V. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The distortion of particle tracks in nuclear emulsions due to pulsed electric fields is studied. Alpha tracks at 5.15 MeV in 200 μ layers of nuclear emulsions in a pulsed field of 1.5 to 6.0×10^4 V/cm were studied, and the results are briefly discussed. (WHK)

3233 (CONF-720724-P1, pp 124-132) TECHNICAL STUDY OF THE EFFICIENCY AND OF OTHER PROPERTIES OF NITROCELLULOSE DETECTORS. Baroni, G.; De Liberto, S.; Petrera, S.; Romano, G.; Sgarbi, C. (Istituto Nazionale di Fisica Nucleare, Rome). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The intrinsic background, detection efficiency, calibration, and use for electron beam dosimetry of dielectric track detectors are studied. (WHK)

3234 (CONF-720724-P1, pp 133-151) EFFICIENCY CALIBRATION OF SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Durrani, S. A. (Univ. of Birmingham, Eng.). 1972.

From eighth international conference on nuclear photography and solid state track detectors, Bucharest, Romania (10 Jul 1972).

The track registration efficiencies of various glasses, plastic and mica for fission fragments of various average energies and for alpha particles have been calculated on the basis of a series of new experiments in which exposures were made in "2π" and other geometries. The effects of temperature and ultra-violet light on the registration efficiencies have been studied. Lastly, certain modifications in standard formulae for source-detector geometry, when applied to SSNTD, are proposed. (auth)

3235 (CONF-720724-P1, pp 178-192) SOME FACTORS AFFECTING THE SENSITIVITY OF PLASTIC TRACK DETECTORS TO α PARTICLE REGISTRATION. Nicolae, M. (Inst. for Atomic Physics, Bucharest). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Results of a study on the effects of pre- and post-irradiation heating, effects of ultraviolet irradiation, and the effects of γ irradiation on the properties of dielectric track detectors are discussed. (WHK)

3236 (CONF-720724-P1, pp 193-199) MECHANISM OF ETCHING PLASTIC DETECTORS. Enge, W.; Grabisch, K.; Bartholomae, K. P.; Beaujean, R. (Univ., Kiel). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

To study the etching mechanism of cellulose nitrate the etching parameters have been varied. Different etchants including LiOH, NaOH, KOH and mixtures of these with other chemicals at various concentrations between 1 and 15 normality have been used at different temperatures between 15° and 50°C. The effects of stirring the etchants and interrupting the etching process have been studied. Comparing the etching behavior of the plastics with the dissociation, the viscosity, and the conductivity of the etchants, new aspects of the etching mechanism have been obtained. (auth)

3237 (CONF-720724-P1, pp 200-212) DAMAGE TRACK REGISTRATION RELATED TO THE THERMAL STABILITY OF POLYMERS. Marchetti, M.; Tommasino, L.; Casnati, E. (CNEN, Rome). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Results of a study to relate the thermal stability and the track registration properties of several organic polymer track detectors are presented. Polyethylene terephthalate foils, polycarbonate foils, and cellulose derivative foils were studied. DSC thermograms (heat capacity as a function of temperature) for different heating rates and track diameters at different pretreatment temperatures are given. (WHK)

3238 (CONF-720724-P1, pp 223-226) DENSITOMETRIC CHARACTERISTICS OF DIFFERENT KINDS OF CELLULOSE NITRATE. Antanasijevic, R.; Juric, M. (Inst. of Physics, Belgrade). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The sensitivity of the various kinds of cellulose nitrate which differ in physico-chemical characteristics mainly in viscosity and degree of nitration was studied. Characteristic curves of the sensitivity are given for different cellulose nitrate films. The densitometric characteristics are compared with the track sensitivity. (auth)

3239 (CONF-720724-P1, pp 227-234) KINETICS OF THE DEVELOPMENT OF α PARTICLE TRACKS IN CELLULOSE NITRATE IN THE COURSE OF CONTINUOUS AND DISCONTINUOUS TREATMENTS. Bermond, J. (Univ., Caen, France). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The response of three cellulose nitrate detectors to continuous and discontinuous treatments was compared by measuring the diameter at the detector surface of 100 tracks of almost normal incidence. In Kodak CA 80-15 the effect of the number of treatments is very sharp; in Kodak LR 115, however, the effect attributed to interruption of the treatment is not sharp. It was determined that if there is an effect connected with discontinuity of the treatment in Kodak LR 115 it is so weak that it can be masked by fluctuations from one operation to the other, particularly temperature variations. (JSR)

3240 (CONF-720724-P1, pp 272-289) INVESTIGATION OF THE SENSITIZATION OF NUCLEAR RELATIVISTIC EMULSIONS DURING CHEMICAL AGING IN ORDER TO OBTAIN EMULSION LAYERS WITH HIGH STABILITY OF PHOTOGRAPHIC PROPERTIES. Myl'tseva, V. A.; Okuneva, O I.; Romanovskaya, K. M.; Chikunova, E. I. 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In order to obtain nuclear relativistic emulsions with high sensitivity of the photographic layers the process of aging of type P emulsions deposited on inert gelatin was investigated. It was established that in the interval studied the concentration of sodium thiosulfate (50 to 8 mg/100 g gelatin) and sodium sulfite (180 to 0 mg/100 g gelatin) does not substantially affect the photographic sensitivity of the emulsion. The size of the grain fog decreased with increase of the concentration of thiosulfate and sulfite and with increase of gold thiocyanide. In the concentration interval studied for Au an excess was better than a deficiency. An increase of Au required an increase of thiosulfate. The stability of the latent images decreased with increase of the thiosulfate in the emulsion and with decrease of the sodium sulfite and gold thiocyanide. Quantitative relations were established between the sodium thiosulfate, sodium sulfite and gold thiocyanide for the production of relativistic emulsions with high photographic sensitivity and high stability of the latent images. (tr-auth)

3241 (CONF-720724-P1, pp 235-252) EFFECTS OF OZONE ATMOSPHERE ON THE DETECTING PROPERTIES OF PLASTIC TRACK RECORDERS. Somogyi, G. (Inst. of Nuclear Research, Debrecen, Hungary). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The effects of an ozone-containing environment on several plastic track detectors including 125 μm Daicel, 100 μm Cellit-T (yellow), 200 μm Makrofol-E, and 150 μm Myraform were studied. Track diameters, number of etched tracks, optical density, and minimum thickness of layer to be removed for obtaining 100% efficiency as a function of particle energy are plotted for foils with and without ozone treatment of latent tracks. (WHK)

3242 (CONF-720724-P1, pp 253-265) INFLUENCE OF THERMAL EFFECTS ON TRACK REGISTRATION CHARACTERISTICS OF PLASTICS. Somogyi, G. (Inst. of Nuclear Research, Debrecen, Hungary). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Studies on the thermal track fading characteristics of plastic track detectors are described. Effects of annealing on the bulk material, effect of annealing on alpha and fission tracks, and selective thermal track eradication are discussed. (WHK)

3243 (CONF-720724-P1, pp 266-271) COLLOID STABILITY OF NUCLEAR PHOTOGRAPHIC EMULSIONS WITH GELATINE SUBSTITUTED BY PVAc-2,4-DISULPHOBENZOALDEHYDE AND POLYVINYL ALCOHOL. Zakharov, V. I ; Novikova, N R.; Perfilov, N. A. (Radium Inst., Leningrad). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Data on the colloid stability of nuclear photographic emulsions with partial or complete substitution of gelatine by polyvinyl-alcohol (PVA) and its derivative PVAc-2,4-disulphobenzoaldehyde are presented. Partial substitution involves silver halide isolation from gelatine emulsions P-9 and PR-2 through centrifugation with subsequent transfer of silver halide into PVA-solution; complete substitution comprises emulsification in

PVAc-medium and subsequent centrifugation which is followed by solid phase transfer into PVA. For gelatine-polymer P_3 (PVA) and PR-2(PVA) emulsions certain zones of silver-halide concentrations with colloid stability of emulsions have been found. The results obtained are interpreted on the basis of the hypothesis of sensitization with residual gelatine of hydrophobic AgHal-sol in PVA-medium. As demonstrated, crucial factors acting on AgHal dispersibility in PVA—for emulsions with complete substitution of gelatine by PVAc and PVA—are the viscosity of emulsified PVAc and conditions of physical ripening. (auth)

3244 (CONF-720724-P1, pp 290-298) DETERMINATION OF THE DEVELOPMENT SPEED OF HEAVY ION TRACKS IN MAKROFOL AND APPLICATION. Tripier, J.; Remy, G.; Debeauvais, M.; Ralarosy, J.; Stein, R. (Centre de Recherches Nucleaires, Strasbourg). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The determination of the development speed $X_Y V_T$ of an ion track in a detector and its expression as a function of the specific energy loss dE/dx of the ion is not a new concept. This curve $V_T = f(dE/dx)$ is a characteristic both of the type of detector and the development conditions chosen. The derivation of this curve in a polycarbonate Makrofol is described and illustrated. The use of the curve in the determination of the mass distributions of light fragments emitted by ternary fission of heavy nuclei at high energy is briefly discussed. (JSR)

3245 (CONF-720724-P1, pp 300-311) EFFECTS OF THE AMOUNT OF CRYSTALLINITY OF A PLASTIC DETECTOR ON THE TRACK CHARACTERISTICS. Bernas, A.; Chambaudet, A.; Bartyge, E. (Univ., Paris). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A study was made to determine if polymer detectors with a definite chemical nature but with initial structures of different ordering have identical track characteristics. Polyterephthalate of ethylene glycol or terphase was used as the detector. The plastic was irradiated with Cf fission fragments. For standard irradiation conditions and the same development technique the tracks were always longer in the crystallized sample than in the amorphous samples. An amorphous sample annealed at 100° for different durations showed the length of the tracks increased with the length of the anneal. No dose effect was observed. (JSR)

3246 (CONF-720724-P1, pp 312-321) ANNEALING OF HEAVY ION TRACKS IN CERTAIN TRACK DETECTORS EXPOSED TO IONIZING RADIATION. Bastin-Schoffier, G. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A study of the stability of heavy ion tracks in solid state nuclear track detectors against ionization effects produced by irradiation with oxygen and helium nuclei is described. When the rate of ionization loss reaches: $\sim 4.10^{15}$ MeV/cm^2/g/sec and $\sim 9.10^{14}$ MeV/cm^2/g/sec, for oxygen and helium respectively, a partial annealing of the tracks occurs which depends on the type of detector. The mechanism of this "ionization" annealing as well as its implication to spallation track dating is briefly discussed. (auth)

3247 (CONF-720724-P1, pp 322-328) SIMPLE METHOD FOR THE DETERMINATION OF ETCH PRODUCTS CONCENTRATION. Paretzke, H. G. (Institut fuer Strahlenschutz, Neuherberg, Ger.). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A method for the determination of the etch products concentration at any time during etching of dielectric track detectors and at any age of the etchant is described. The method is based on the characteristic optical absorption of the etch products. (WHK)

3248 (CONF-720724-P1, pp 329-349) METHOD DEVELOPED TO ASSURE OPTIMUM PLASTICIZING OF PHOTOGRAPHIC LAYERS FOR NUCLEAR STUDIES. Myl'tseva, V. A.; Uvarova, V. M. (Moscow State Univ.). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Becharest, Romania (10 Jul 1972).

In order to obtain photographic layers for nuclear studies with satisfactory physico-mechanical properties with low moisture content of the medium, studies were made on the mechanical properties and moisture of gelatin and emulsion layers plasticized with surface-active materials and polyhydric alcohols. The concentration of the plasticizing material in the layer was determined; an increase of the natural hydroscopy of the gelatin in the layer did not occur at different moisture concentrations of the medium. The difference in the plasticizing effects of the materials was established. It was shown that the optimum plastification of the gelatin and photographic layers is achieved by combination of low-hydroscopic surface-active materials (for example, the sodium salt of diethylhexyl ether sulfosuccinic acid) with polyhydric alcohols (glycerine for example). (tr-auth)

3249 (CONF-720724-P1, pp 350-364) REVIEW OF AgCl-CRYSTALS AS VISUAL DETECTORS OF NUCLEAR PARTICLES. Schopper, E. (Univ., Frankfurt am Main); Granzer, F.; Henig, G.; Schott, J. U.; Dardat, K.; Wendnagel, T.; Haase, G.; Zoergiebel, F. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Research on the use of relatively large thin silver chloride crystals for ion detection is summarized. The detectors studied consist of 200μ layers of 1.5- to 2.5-cm silver chloride crystals on thin quartz glass plates. Crystal growth, theory of latent track formation, development procedure (which consists simply of irradiation with ultraviolet light) and ion detection characteristics are discussed. (WHK)

3250 (CONF-720724-P1, pp 365-372) MECHANISM OF TRACK FORMATION IN Cd DOPED AgCl DETECTORS. Granzer, F. (Univ., Frankfurt am Main); Schopper, E.; Dardat, K.; Henig, G.; Schott, J. U.; Haase, G.; Zoergiebel, F. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The mechanism of track formation in thin film Cd-doped Ag(Cl) monocrystals is studied. The structural and chemical properties of the crystals, latent image formation, and the stabilizing influence of a simultaneous inactinic illumination on the latent track are discussed. (WHK)

3251 (CONF-720724-P1, pp 373-383) DETECTING PROPERTIES OF AgCl (Cd) DETECTORS FOR IONIZING PARTICLES. Schott, J. U. (Univ., Frankfurt am Main); Schopper, E.; Granzer, F.; Dardat, K.; Henig, G.; Haase, G.; Zoergiebel, F. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Latent image properties of thin sheet AgCl(Cd) monocrystal detectors are discussed. The time constant of latent image fading and the conditions of latent image stabilization by irradiation with inactinic light ($\lambda > 430$ nm) were studied, and results are presented and discussed. (WHK)

3252 (CONF-720724-P1, pp 384-393) RADIOBIOLOGICAL AND DOSIMETRIC APPLICATIONS OF AgCl DETECTORS. Henig, G. (Univ.,Frankfurt am Main); Schopper, E.; Granzer, F.; Dardat, K.; Schott, J. U.; Wensel, A.; Buecker, H.; Horneck, G.; Haase, G.; Zoergiebel, F. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Two examples of applications of AgCl-detectors are presented: 1) Spores of Bacillus subtilis are glued with PVA on the surface of AgCl-detectors. The spores are irradiated by ionizing particles. By a simple dry development the tracks of these particles are made visible in the detector with a spatial resolution better than 1 micron without removing the spores and without damaging them. As the spores have a size of merely 1 micron, their fixed position and the high spatial resolution of the AgCl-detectors is most important for the assignment of tracks and hit spores. 2) AgCl-detectors were irradiated by neutrons with doses of 3×10^5 to 3×10^9 neutrons/cm^2, the neutron energy being 1.2, 5.5 and 16.1 MeV. The reactions Cl(n,α), Cl(n,p), Ag(n,α) and Ag(n,p) within the crystal volume resulted in tracks of protons and of α-particles according to the different cross sections. Number and length of these tracks permit measurements of the neutron rate and of the maximum neutron energy. The influence of γ-radiation on the detector response was investigated. Accompanying γ-radiation does not influence AgCl neutron dosimetry at doses below 200 R. (auth)

3253 (CONF-720724-P1, pp 394-436) PROBLEM OF TRANSURANIUM ELEMENTS DETECTION IN THE COSMIC

RADIATION. Zhdanov, G. B. (Inst. for Cosmic Research, Moscow). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

After a brief review of the arguments in favor of the existence of "islands" of stability for the transuranium elements around 114 and 126 nuclear charges, those experimental aspects of the problem of detection of the relatively stable transuranium elements with $Z \geq 110$ are analyzed which refer especially to nuclei with mean life time $> 10^6$ y and which are directly related to the nuclear composition of the primary cosmic radiation research program. Thus the attempts made and the outlook of detecting nuclei with $Z \geq 110$ at accelerators and in "natural conditions" (earth, moon, meteorites) are analyzed and the problem of heavy and superheavy nuclei detection in nuclear emulsions is amply discussed with special stress on the factors on which the accuracy of the Z measurements depends: the measurable track length, the precision with which the particle velocity is known, the calibration with respect to nuclei of known charge, the accuracy in the measurement of the track photometric characteristics, marginal effects at the emulsion surface, the background due to different other particles and the fluctuations which appear in the tracks of the latter. From a comparison of the nuclear emulsion characteristics with those of solid state (dielectric) track detectors, the necessary factors for an optimal planning of the experiments of transuranium nuclear detection in the cosmic radiation are obtained, as well as the prospects of such experiments. (auth)

3254 (CONF-720724-P1, pp 485-499) MINERAL DETECTORS AND HEAVY ION TRACKS AT VERY LOW ENERGY ($0.2 < E < 200$ keV/amu). Bibring, J. (CSNSM, Orsay, France); Borg, J.; Dran, J.; Maurette, M.; Meunier, R.; Peters, J.; Walker, R. 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Preliminary results are reported on the registration characteristics of very low energy ion tracks in micas, lunar minerals, and meteorites. The micas were exposed to low energy ions (0.2 to several keV/amu) and etched for 2 hr at 30°C in 40% hydrofluoric acid. The preliminary results showed that Fe ions give etchable tracks even at energies close to 0.2 keV/amu; the depth of the corrosion figures increased with increase of energy. High flux irradiation of lunar minerals and meteorites causes the formation of a very thin skin of amorphous material. The critical flux above which this skin effect occurs is dependent on the ion mass and the mineral species. Application of this technique to the study of the solar wind, thermal properties of the solar wind in the past, detection of superheavy elements, study of low energy fusion reactions, detection of very heavy and very unstable isotopes formed during nuclear reactions, and the study of the wall reaction in fusion reactors is discussed. (JSR)

3255 (CONF-720724-P1, pp 526-536) ANALYSIS OF IMAGES CAUSED BY $Z \geq 60$ COSMIC RAY PRIMARIES IN A FAST-FILM CHERENKOV DETECTOR. Pinsky, L. S. (Manned Spacecraft Center, Houston, TX); Eandi, R. D.; Rushing, R. B.; Thomson, L. F.; Osborne, W. Z. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A fast-film Cherenkov detector for energetic, extremely heavy nuclei has been tested in balloon flights of large area detector arrays which also included nuclear emulsions and plastic track detectors. A total exposure of roughly 1.5×10^3 m^2 hours has been accumulated at altitudes above 6 gm/cm^2 of residual atmosphere. The Cherenkov detectors are designed to provide velocity measurement for particles with $\beta \geq .68$ and $Z \geq 60$. For 27 of the events found in the nuclear emulsion with estimated charges of at least 50, the Cherenkov detectors have survived and are usable, and 10 have corresponding Cherenkov images. Many of those with no Cherenkov images appear in the nuclear emulsion to be slow, or have charges which are possibly <60, and no obviously fast particles have failed to yield Cherenkov images for estimated charges of at least 60 where the Cherenkov detectors are usable. (auth)

3256 (CONF-720724-P1, pp 537-544) REGISTRATION PROPERTIES OF PYROXENES FOR VARIOUS HEAVY IONS AND CONSEQUENCES TO THE DETERMINATION OF THE COMPOSITION OF THE COSMIC RADIATION. Plieninger, T.; Kraetschmer, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Mineral crystals used as track detectors for the heavy component of the cosmic radiation were calibrated for the first time by bombardment with artificially accelerated Ca, Fe, and Cu ions of sufficient energy to generate complete tracks in the interior of the crystals. The track lengths were measured to be 4 ± 1 μm for Ca, 20 ± 1 μm for Fe, and 30 ± 1.5 μm for Cu ions. The artificial tracks are directly comparable to the fossil cosmic ray tracks. Whereas the Ca lengths coincide with a peak in the length distribution of the fossil cosmic ray tracks, artificial Fe tracks are longer than most fossil tracks. Preliminary annealing experiments by heating and electron bombardment indicate that fossil tracks are not shortened to such an extent under lunar surface conditions. (auth)

3257 (CONF-720724-P1, pp 591-597) SOME APPLICATIONS OF NUCLEAR TRACK DETECTORS IN MONITORING OF HEAVY PARTICLE IRRADIATION OF BIOLOGICAL TARGETS. Benton, E. V.; Tobias, C. A. (Univ. of San Francisco). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Plastic nuclear track detectors are being utilized in monitoring of heavy particle irradiations of biological targets. With accelerator particle beams, particularly when Bragg peak type exposures are utilized, it is important to precisely define the three dimensional character of the beam. This becomes essential when utilizing very thin biological targets such as cells. Techniques for defining the shape of the Bragg peak and determining the number of hits of a small target are described. (auth)

3258 (CONF-720724-P1, pp 624-628) PHOTOGRAPHIC EMULSIONS AND AUTORADIOGRAPHIC METHODS IN ELECTRON MICROSCOPIC STUDIES. Bogomolov, N. S.; Khruleva, L. S.; Razorenova, I. F.; Kozinets, G. I.; Talenova, N. N.; Al'perovich, V. V. (Central Scientific Research Inst. of Hematology and Blood Transfusion, Moscow). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The use of autoradiography in electron microscopy makes possible studies at the subcellular level. The characteristics of an emulsion developed for use in autoradiography of cultures are reported. Typical photographs of lymphocyte cultures are shown. (JSR)

3259 (CONF-720724-P2) PROCEEDINGS OF THE 8TH INTERNATIONAL CONFERENCE ON NUCLEAR PHOTOGRAPHY AND SOLID STATE TRACK DETECTORS, BUCHAREST, Romania; JULY 10–15, 1972. Volume II. Nicolae, M. (ed.). (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 482p. (In several languages).

Separate abstracts were prepared for the 50 papers presented. (WHK)

For abstracts of individual papers see: 3132, 3180, 3260–3279, 3330–3334, 3355, 3374, 4080, 4124, 4125, 4336, 4337, 4523, 4538, 4645, 4919–4925, 5037, 5087, 5088, and 5103–5105.

3260 (CONF-720724-P2, pp 16-26) APPLICATION OF SOLID STATE TRACK RECORDERS TO NUCLEAR FISSION STUDIES. Roberts, J. H. (Macalester Coll., St. Paul). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A review of the wide range of applications of solid state track recorders to precision work in nuclear fission studies is given. The unique advantages and the high precision obtained are stressed. The applications reported include measurements of spontaneous fission decay constants, angular distributions of fission fragments, fission rate distributions in fast reactors, absolute thermal neutron density measurements, fission yields of selected radioisotopes, and fast neutron dosimetry. Whereas most of the fission track counting has been done by scanners, the development of a fully automated computer controlled track counting system at the Argonne National Laboratory is reported. This review is limited to the work in which the author has been directly or indirectly involved. (auth)

3261 (CONF-720724-P2, pp 27-54) USE OF DIELECTRIC DETECTORS IN PHYSICS RESEARCH. Perelygin, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Nuclear physics applications stimulate the further development of the dielectric track detector method. For some purposes new detectors with required properties were developed (phosphate glass, cellulose nitrate and others). The sensitivity of detectors

varies very widely. The less sensitive are synthetic glasses which have a threshold in the region of 6 MeV/nucl for ^{61}Zn ions, and topaz, and olivine crystals with the threshold in the region of 5 to 5.5 MeV/nucl for Zn ions. Some proofs for the existence of the "saturation effect" in the glass detectors (and crystals) were found. This effect reveals in some glasses a constant etching rate for Zn ion tracks in a wide range of energy losses and for fission fragment tracks. The method based on the selective annealing of latent tracks could be used not only for the elimination of less ionizing ion track backgrounds (for example, binary and ternary fission investigations with Ar and Ca ions) but also for reducing the full etchable track length, which corresponds to the applications of the detectors with lower threshold of registration. Double layer plastic detectors were developed for the registration of very rare fission events (less than one event per square meter). The coincidence between a spark discharge on the thinner layer and the prolongation of the track on the adjacent area of the second plastic provides a decisive proof for the registration of fission fragment tracks in these detectors. The application of dielectric track detectors for the investigation of spontaneously fissioning isomers, syntheses and investigations of the physical and chemical properties of transmendeleevium elements for nuclear fission investigations are discussed. The plastic, mineral, and glass detectors are widely applied for search of very far transuranic elements in the terrestrial and extraterrestrial samples and for direct registration of the heavy and superheavy cosmic nuclei (auth)

3262 (CONF-720724-P2, pp 112-118) EVALUATION OF THE RANGE OF CORRELATIONS IN MULTIPLE SCATTERING. Cincheza, L.; Friedlaender, E. M. (Inst. for Atomic Physics, Bucharest). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A very rigid statistical evaluation of the tracks in a nuclear emulsion from high-energy π^- beams showed that, even if long-range correlations are present, their influence is negligible for all practical purposes. This justifies the use of a previously proposed formula for the evaluation of the Coulomb signal. (3 figures, 1 table) (JSR)

3263 (CONF-720724-P2, pp 119-121) DETERMINATION OF THE MULTIPLE SCATTERING OF PARTICLES WHOSE TRAJECTORIES ARE INCLINED IN RELATION TO THE PLANE OF THE EMULSION. Willot, B.; Schune, D.; Meton, C. (Univ., Paris). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In a previous study of the interaction of 3-GeV/c antiprotons with emulsion nuclei, a more or less pronounced curvature was found for each section of the track. In order to determine if this curvature was due to emulsion deformation or was a phenomenon of the multiple scattering, a computer simulation was made of tracks and the number of tracks was determined as a function of the sagitta height. A flattening of the spectrum and a displacement of the maximum toward the right when the p^2c decreases was observed. (2 figures) (JSR)

3264 (CONF-720724-P2, pp 143-152) EFFECT OF SOME FACTORS ON THE PRECISION OF THE MEASUREMENT OF CHARGED-PARTICLE MOMENTUM IN MULTIPLE SCATTERING IN NUCLEAR PHOTOEMULSIONS. Larionova, V. G.; Orlova, G. I.; Tret'yakova, M. I. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Data on the dependence of the size of the distortion on the length of the cell from the measurement of multiple scattering on the tracks of the primary particle were reported for type BR-1 layers with a thickness of 600 and 800 μ and a BR-2 layer with thickness of 400 μ irradiated with 10-GeV particles. Data on the dependence of the noise ($D = \sqrt{D^2_{momentum} - D^2_{Coulomb}}$) on the length of the cell, t, for different inclination angles were presented for BR-2 layers of 600 μ thickness and 10×10 cm^2 dimensions irradiated with 50-GeV π^- mesons at angles $\alpha = 0.5$, 2.0, and 4.5° to the emulsion plane. The multiple scattering on 200 tracks of the primary particle was measured for BR-2 layers of different wetness with a thickness of 600 to 700 μ irradiated with 60-GeV π^- mesons or 67-GeV protons. Data on the size of the noise and the value of the momentum obtained from the second difference of D are reported. Corrections to $\rho = T/D$ are considered. (5 figures, 1 table) (tr-auth)

3265 (CONF-720724-P2, pp 207-218) DIELECTRIC DETECTORS USED IN NUCLEAR REACTION STUDIES. Vilcov, N. (Inst. for Atomic Physics, Bucharest). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Experiences in the use of dielectric track detectors in nuclear reaction studies at the IAP cyclotron in Bucharest are summarized. The basic properties of dielectric track detectors and the range of utilization, types of dielectric track detectors for nuclear reaction studies, and experimental techniques based on dielectric track detectors are briefly discussed. The main field concerns nuclear fission and particularly the fission isomers of transuranic nuclei. (WHK)

3266 (CONF-720724-P2, pp 219-223) SOME CHARACTERISTICS OF PHOTOEMULSION LAYERS OF THE BRx4y TYPE WITH INCREASE IN CONCENTRATION OF HYDROGEN AND LIGHT NUCLEI. Tret'yakova, M. I. (Inst. of Physics, Moscow); Chernyavskii, M. M.; Bogomolov, K. S.; Myl'tseva, V. A.; Chikunova, E. I.; Bokova, L. I.; Lyubomilov, S. I.; Baranov, V. I. 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Data are presented on the sensitivity, size of the distortion, and spurious scattering of type BRx4y emulsion layers. (tr-auth)

3267 (CONF-720724-P2, pp 231-241) PROPERTIES OF GLASS DETECTORS AND THEIR USES. Otgonsuren, O.; Perelygin, V. P.; Tret'yakova, S. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The results of tests on the determination of the sensitivity of some silicate and phosphate glasses to heavy charged particles—accelerated ions of ^{16}O, ^{22}Ne, ^{31}P, ^{32}S, ^{35}Cl, ^{40}Ar, ^{65}Zn, and fission products—are reported. It was shown that the different glasses have different thresholds for the registration of charged particles. The diameter of the track in the glass at first increases with increase of the ionization caused by the charged particles but then at some level of ionization the tracks remain constant. This result is interpreted as evidence of the saturation of the zone of defects caused in the glass by heavy charged particles. (tr-auth)

3268 (CONF-720724-P2, pp 242-246) STUDY OF THE MECHANISM OF FISSION AT LOW ENERGY USING GASEOUS SCINTILLATORS AND PLASTIC TRACK DETECTORS. Chastel, R.; Sicre, A.; Leroux, B.; Doan, T. P. (CEN, Bordeaux). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Plastic detectors were used to detect the fission products from ^{232}Th, ^{231}Pa, and ^{234}U irradiated with low energy neutrons. The experimental set-up for the measurement of the angular distributions is shown. As an example the cross section curve for $^{231}Pa(n,f)$ is given to show the improvements that can be made in the precision by the use of plastic detectors rather than gas scintillators which are restricted by γ radiation. (JSR)

3269 (CONF-720724-P2, pp 247-354) DETERMINATION OF THE ENERGY THRESHOLD FOR NEUTRON DETECTION IN POLYMER FOIL TRACK DETECTORS. Jozefowicz, K. (Inst. of Nuclear Research, Swierk, Poland). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Polycarbonate foils such as Makrofol or Lexan are able to register fast neutrons by recording carbon and oxygen recoil atoms from neutron elastic collisions as well as alpha particles from $C(n,\alpha)$ and $O(n,\alpha)$ reactions. The calculation and experimental determination of the neutron energy threshold for Makrofol E track detectors is described. The detection efficiency is plotted as a function of the neutron energy. The minimum energy for neutron detection was found to be approximately 0.8 MeV. (WHK)

3270 (CONF-720724-P2, pp 305-316) CALIBRATION OF PLASTIC DETECTORS FOR LOW ENERGY COSMIC RAYS. Blanford, G. E. Jr.; Fain, J.; Monnin, M.; Montret, M.; Touzery, C. (Univ. de Clermont, Clermont-Ferrand, France). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Two plastics of different track registration sensitivity, cellulose triacetate (Bayer Triafol TN) and polycarbonate resin (Bayer Makrofol KG), were placed on the lunar module of the Apollo XVI mission to study low energy ($E < 50$ MeV/nucleon), light, medium and heavy cosmic rays ($3 < Z < 30$). The calibration of these track detectors using two methods is presented. With accelerated heavy ions, the power law relationship (calibration curve) between the average track etching rate and the primary ionization of the par-

ticle is shown. In the second method, a relationship between the time for the tracks to etch to a length of 10 μm (apparition time) and the primary ionization is used. The sequential etching method used to find the apparition time is described. It is stated that one should be able to measure the range and to determine the ionization of the cosmic ray particles with sufficient accuracy to evaluate the charge of the cosmic rays within ±2 atomic units. (auth)

3271 (CONF-720724-P2, pp 319-328) DOSIMETRY OF RADON. Chapuis, A. M.; Dajlevic, D.; Duport, P.; Soudain, G. (CEA, Grenoble, France). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The risks caused by Ra inhalation are evaluated by measurement of the total α energy emitted by its descendants. The aerosols are retained on a filter. The number of α particles emitted on the filter is measured with cellulose nitrate. The apparatus makes it possible to detect separately the α particles from RaA and RaC'. (tr-auth)

3272 (CONF-720724-P2, pp 329-332) DISPERSION OF REGISTRATION THRESHOLDS AFTER DISCRIMINATIONAL DEVELOPMENT OF NUCLEAR EMULSIONS. Zakharov, V. J.; Kocherov, N. P.; Novikova, N. R.; Perfilov, N. A. (Radium Inst., Leningrad). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Registration properties of nuclear emulsions were studied after development in inorganic ferro-oxalate developing agent at different redox potentials of the developing solutions. Experimental data on the spread of proton registration thresholds are cited for relative loss region from 50 to 350 MeV per cm. (auth)

3273 (CONF-720724-P2, pp 340-346) NEUTRON FLUENCE MEASUREMENTS BY FISSION TRACK METHOD USING THE FISSIONABLE ELEMENT IN SOLUTIONS AND GLASSES. Danis, A. (Inst. for Atomic Physics, Bucharest); Tommasino, L.; Oncescu, M. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In thermal neutron fluence measurements by the fission track technique the constant K for U-2 and U-3 Brill's standard U glasses using gold foil activation is determined. The possibilities of using the fissionable element in solutions for neutron fluence measurements by the same technique are described. The fluence measurements were performed in the Thermal Column of Triga-reactor Casaccia-Roma and in the Thermal Column nr. 3 of VVR-S reactor, Bucharest. Makrofol and Melinex and mica-muscovite were used as SST detectors. Tracks were counted by optical microscopy at 450 times magnification. (auth)

3274 (CONF-720724-P2, pp 386-401) STUDY OF COSMIC RADIATION BY USE OF PLASTIC DETECTORS AND THE ACCURACY OF THE METHOD. Fukui, K. (Univ., Kiel). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Three plastic detectors, cellulose, nitrate of Daicel, Lexan polycarbonate of General Electric, and cellulose nitrate of Kodak Pathe are currently available and widely used for the study of cosmic radiation. The characteristic differences are described, and their applications to the special problems of detecting cosmic radiation are discussed. These include charge identification of low energy heavy nuclei, isotopic components of light nuclei, and their application to biological work. The accuracy and limit of the measurement by this method as well as the scanning method are discussed. (auth)

3275 (CONF-720724-P2, pp 402-406) HEAVY ION BOMBARDMENT OF SOLID STATE TRACK DETECTORS. Durrani, S. A.; Mallik, S. R.; Khan, H. A. (Univ. of Birmingham, Eng.). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In an effort to understand the charged-particle track phenomena in lunar materials, heavy-ion bombardments were carried out on a number of solid state track detectors (soda-lime glass, muscovite mica, plastic (Makrofol), and olivine crystals). The beams used were those of ^{56}Fe (charge state 9^+, total energy 40 MeV) and ^{16}O (6^+, 35 MeV), accelerated in the 12 MeV Van de Graaff Tandem Generator at AERE, Harwell. The charged particle track phenomena including variables of charge, energy, and intensity were studied to aid in the interpretation of particle tracks in lunar glasses and crystals. (WHK)

3276 (CONF-720724-P2, pp 425-432) AUTOMATIC MEASUREMENTS OF TRACKS IN SOLID STATE TRACK DETECTORS WITH A SPARK-COUNTER, AN ON-LINE FLYING SPOT- AND TV-DEVICE, AND WITH COHERENT OPTICS. Abmayr, W. (Institut fuer Strahlenschutz, Neuherberg, Ger.); Burger, G.; Gais, P.; Paretzke, H. G.; Platzer, H. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The advantages and limitations of some automatic readout systems for dielectric track detectors are outlined. The spark counter, on-line flying spot device, on-line tv-camera device, and coherent light scattering method are discussed. (WHK)

3277 (CONF-720724-P2, pp 433-439) DIGITAL GAP METER FOR MEASURING THE IONIZATION. Friedlaender, E. M.; Friedlaender, J.; Marin, A. G.; Visky, T. (Inst. of Atomic Physics, Bucharest). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The techniques used at the Institute of Atomic Physics in Bucharest for the measurement of the ionization of tracks in nuclear emulsions are described. The techniques are based on the use of an on-line digital gap meter with a multichannel analyzer. The program for the calculation of the ionization is outlined. (JSR)

3278 (CONF-720724-P2, pp 440-449) FACTORS AFFECTING THE ACCURACY OF SPARK COUNTING OF FISSION FRAGMENT DAMAGE TRACK DETECTORS. Cross, W. G.; Tommasino, L. (Chalk River Nuclear Labs., Ont.). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

It is often desirable that the accuracy of track density measurements be limited only by counting statistics. Errors in spark counting of tracks traversing thin foils arise from failure of some tracks to pass a spark within a reasonable time, from double sparking in a track and, at high track densities, from overlapping of holes in the thin Al electrode. Counting accuracy has been determined by (a) measuring reproducibility of repeated counts of the same foil, (b) measuring the plateau slope in the curve of counts vs voltage, (c) comparing the spark count with a visual count of holes and (d) comparing hole patterns in spark replicas from two foils traversed by the same fission fragments. Length and slope of the voltage plateau were found to depend on foil thickness, polarity of the thin electrode, capacitance and charging resistance, track density, time between sparks and air pressure. Removal of evaporated Al from the foil is important for reproducibility of repeated counts. Double sparking is reduced by varying the air pressure during counting in such a way that all sparks occur at nearly the same voltage. For moderate track densities, in insulators 10 μm thick, repeated counts of the same foil were reproducible to 0.5% and the number of sparks counted varied by 2% between 400 and 800 volts. At high hole densities, smaller counting losses were obtained in an atmosphere of He, which permits lower sparking voltages. Losses were proportional to track density up to 5000 tracks/cm^2 when 10% of the tracks were lost. (auth)

3279 (CONF-720724-P2, pp 450-452) FORMATION OF COORDINATE GRID ON PLASTIC DETECTORS. Birabeau, J. P. (CERN, Geneva); Brun, M.; Brun, R.; Cordaillat, A.; Mendola, O. 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In order to facilitate the locating of tracks of charged particles in cellulose nitrate and polycarbonate (makrofol, lexan) foils, a method has been developed for the photo-deposition of translucent coordinate grids on these materials. The grids are resistant to the strongly caustic solutions used in developing tracks in plastic foils. (auth)

3280 (CONF-740430-1) "FAMILY IMAGE" FOR EVALUATION OF PROCESSING OF RADIOISOTOPE IMAGES. Dillon, R. S.; Ross, D. A.; Bell, P. R.; McClain, W. J. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 8p. Dep. NTIS $4.00.

From southeastern regional meeting; Nashville, Tennessee, USA (18 Apr 1974).

In order to meet the needs of testing computer processing of radioisotopic images for accuracy, a wholly synthetic image representing the distribution of a radiotracer within a patient's body has been developed using a minicomputer. This "family image" can be readily adjusted to match the correct degree of resolution, gamma-ray scatter, collimator penetration, and counting statistics corresponding to the detector system, radionuclide, dose, and imaging time of a particular scan. The images are useful in testing processing methods since the "true" details of the original object are known. They also serve the additional functions of teaching aids in the uses of a specific nuclide, of demonstrating the effects of various doses and counting times, and of demonstrating changes to be expected by a change of collimator or display format. (auth)

3281 (CONF-740430-2) USE OF A MINICOMPUTER AS AN ON-LINE DEVICE FOR RADIOISOTOPIC IMAGING. McClain, W. J.; Bell, P. R.; Dillon, R. S. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 24p. Dep. NTIS $4.25.

From southeastern regional meeting; Nashville, Tennessee, USA (18 Apr 1974).

The minicomputer is gradually coming into its own as an on-line device in the nuclear medicine clinic. This paper describes the Oak Ridge Scanning System (ORSS-74), an application of the DEC PDP-8 system to accumulate radioisotopic scan data from imaging devices, to process the data to correct for statistical and detector anomalies, and to display the resulting images as intensity maps on a cathode-ray tube. The system provides console control of the accessing, processing, and displaying functions with commands issued on the teletypewriter. Five display modes facilitate visual interpretation of the data, permitting both low- and high-level tumors and other abnormalities within the patient to be detected. (auth)

3282 (EGG-1183-2292) ENTRANCE WINDOW, SPECTRAL, AND COLLIMATION EFFECTS ON GAMMA-RAY EXCITED IMPULSE RESPONSES AND INTERNAL EMP. Stevens, J. (EG and G, Inc., Goleta, Calif. (USA)). Jul 1972. Contract AT(29-1)-1183. 28p. Dep. NTIS $4.00.

For California Univ., Livermore. Lawrence Livermore Lab.

The gamma-ray excited impulse response of an evacuated Compton detector was measured as a function of entrance window, gamma-ray spectrum, gamma-ray beam collimator, and recording system bandwidth. The response was found to be independent of gamma-ray spectrum but strongly dependent on the entrance window. Very high frequency signals, probably associated with cavity excitation, resulted from reducing the collimation diameter. For a 500-MHz bandwidth recording system there appears to be little difference between 4- and 1-inch collimation. The initial portion of the impulse response contains a large negative signal which is correlated with entrance window emission. This signal is short compared to the subsequent positive signal, and therefore slow recording systems suppress it along with high frequency cavity ringing. (auth)

3283 (IAEA-R-991-F) EVALUATION OF COLLIMATORS FOR SCINTIGRAPHY. Final Report, 1 January 1971–31 December 1972. Isialas, S. P. (International Atomic Energy Agency, Vienna (Austria)). Apr 1972. 7p. INIS.

Spatial resolution, sensitivity, and septa penetration of focused collimators for rectilinear scanning were determined from the response to a uniform line source of ^{198}Au, ^{131}I, and ^{125}I. The pulses from the detector were analyzed and stored in a 400-channel analyzer operating in a multiscaler mode. The raw data were punched on computer cards and the COLSCI program run on a CDC-330 computer, which calculated LSF, FWHM, and MTF. Three plane sources of ^{198}Au, ^{131}I, and ^{241}Am, and a special homemade collimator were employed for the determination of the total sensitivity and septa penetration fraction. The septa penetration fraction depended mainly on the collimator material, geometric specifications of the collimator and the photon energy of the radionuclide used. The high percentage of septa penetration was mainly due to inadequate septa thickness and partly to insufficient shielding of the detector system. Since the maximum acceptable septa penetration fraction is 18%, it is rather obvious that firms have to redesign collimators which show unusually high penetration fraction values. (INIS)

3284 (ITEF-38) STABILIZATION AND ABSOLUTE CALIBRATION OF MULTI-TRACK TIME-MEASURING SYSTEMS FOR SCINTILLATION COUNTERS BY THE METHOD OF BENCH MARKS. Barkov, B. P.; Katinov, Yu. V.; Sutormin, A. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 19p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

A method and a benchmark time-reference system for a multitrack scintillation counter measurement system are described. The reference stability of the time measurement is at least ±80 psec for every track. The systematic error is no more than 150 psec. (tr-auth)

3285 (JINR-P13-7154) DATA OF THE WORKING COMMITTEE ON THE METHODICS OF PROPORTIONAL CHAMBERS, DUBNA, MARCH 27–30, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 173p. (In Russian). (CONF-730349-).

Separate abstracts were prepared for the 20 papers presented. (WHK)

For abstracts of individual papers see: 3286–3290, 3379–3388, 4081–4084, and 4108.

3286 (JINR-P13-7154, pp 9-24) USE OF PROPORTIONAL CHAMBERS IN PHYSICS EXPERIMENTS. (Review). Korenchenko, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The basic properties of proportional chambers are briefly outlined. Their use for monitoring or the determination of the beam profile of primary beams, for spatial or angular distributions of charged particles in large spectrometers, for installations with a large solid angle for detection of secondary particles, for detection of particles in the focal plane of a magnetic spectrograph, and for the detection of low-energy radiation is discussed. (27 references) (JSR)

3287 (JINR-P13-7154, pp 25-35) USE OF PROPORTIONAL CHAMBERS FOR CREATION OF A SELECTIVE TRIGGER. Guzik, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

By use of a proportional chamber in association with an electronic circuit, different selection criteria can be developed such as the passage of a particle through the installation, the presence of a given quantity of registering particles, or a given angular and kinematic dependence. Installations using proportional chambers as selective triggers with these criteria are described as illustrations. (JSR)

3288 (JINR-P13-7154, pp 74-79) PORTABLE PROPORTIONAL CHAMBER. Damaskinskii, E. A.; Kashuk, A. P.; Krivshich, A. G.; Panichev, V. I.; Prokof'ev, O. E.; Samsonenkov, V. S. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The design, construction, and characteristics of a portable wire proportional chamber are outlined. The instrument is constructed of common elements and is suitable for industrial use. (JSR)

3289 (JINR-P13-7154, pp 80-84) DEVELOPMENT OF A PROPORTIONAL CHAMBER AT THE INSTITUTE OF NUCLEAR PHYSICS, KRAKOW. Dvurazny, A.; Yanchur, V.; Knapik, I.; Turala, M. (Inst. of Nuclear Physics, Krakow). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

Proportional chambers with plane and cylindrical geometry were constructed for position and angular measurements. The design of each type is briefly outlined. (JSR)

3290 (JINR-P13-7154, pp 95-100) CHARACTERISTICS OF A PROPORTIONAL CHAMBER WORKING WITH AN Ar + CH_4 MIXTURE. Damaskinskii, E. A., Kashuk, A. P.; Krivshich, A. G.; Prokof'ev, O. E.; Samsonenkov, V. S. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The efficiency, time and energy resolution, and intrinsic noise of proportional chambers filled with an Ar–CH_4 mixture were studied. It was established that an increase of the concentration of CH_4 in the mixture leads to a decrease of the intrinsic noise and an improvement of the time resolution. In experiments where the position of charged particles must be determined and not the energy, operation with pure CH_4 has the advantage of high time resolution, low background noise, and no preparation of the working mixture. (JSR)

3291 (LUIP-CR-74-2) VIDICON NUCLEAR TRACK PHOTOMETER. von Friesen, S. (Lund Univ. (Sweden). Fysiska Institutionen). Feb 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

A nuclear track photometer which has been developed at the Department of Cosmical High Energy Physics at the University of Lund is described. It consists of a Type B Leitz microscope with a Nikon camera adapter, where the image of the track is viewed by a Vidicon tube of a Philips type EL 8000 "Compact" TV-camera. The camera has been slightly modified to bring out the video signal before the addition of the synchronization pulses. The vertical and horizontal pulses are brought out separately. The adjustment and focusing of the image are made by means of a TV monitor. (auth)

3292 (SLA-74-177) LOW-TEMPERATURE ELECTRICAL RESISTIVITY CHARACTERISTICS OF FAST-NEUTRON-IRRADIATED CdS: NEW CONCEPTS IN NEUTRON DETECTION. Johnson, R. T. Jr. (Scandia Labs., Albuquerque, N. Mex. (USA);

Sandia Labs., Livermore, Calif. (USA)). Mar 1974. Contract AT(29-1)-789. 39p. Dep. NTIS $5.00.

Time dependent electrical resistivity changes at low temperature in fast-neutron irradiated CdS have been studied. The experiments were on low-resistivity single crystals, and the electrical changes result from radioactive decay effects induced by the fast-neutron irradiation. Results show that following neutron irradiation and upon lowering the sample temperature, the resistivity decreases with time and approaches a stable value. These effects are attributed to trapping phenomena, and can be erased by increasing the temperature. The time dependent electrical changes associated with radioactive decay provide a new means for neutron detection. (auth)

3293 (UNI-90) AUTOMATIC BACKGROUND COMPENSATING HAND AND SHOE MONITOR. Arnold, D. F. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 24 Oct 1973. Contract AT(45-1)-1857. 12p. Dep. NTIS $4.00.

Specifications, operation, circuit description, and calibrating equipment for a detector system for monitoring contamination on the hands and feet of personnel are discussed. The monitor uses 24 mica window pancake GM tubes to detect contamination on the monitored person. Each section (right-hand, left-hand, and feet) uses eight GM tubes. (WHK)

3294 DETECTION OF CRITICALITY ACCIDENTS. Study and Development of a New Type of Device. Prigent, R.; Renard, C. (CEN, Fontenay-aux-Roses, France). pp 205-214 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

A criticality probe that produces an alarm signal when it is subjected to critical excursions having doubling times ranging from 0,2 m sec to 200 sec is described. The alarm signal is given when the integrated dose (neutron + γ) is equal to 25 mrad, the critical excursion range being that previously envisaged. A plastic scintillator is used in conjunction with an enriched boron scintillator for the detection. Both are placed in a polyethylene cylinder. The light pulses delivered by the scintillators are transformed into an average dc current by a photoemissive cell fed by a low tension source (10 volts). The average current is integrated by an integrating circuit and the information obtained is transmitted at low impedance by a very small leakage current operational amplifier. Currents varying from 10^{-6} to 10^{-12} amps (dynamic range 10^6) are measured. (FR)

3295 TECHNOLOGY OF MACHINING PLASTIC FOR THE LIGHTGUIDES OF SCINTILLATION COUNTERS. Volkov, A. E.; Gusev, V. V.; Kolachev, G. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1596-1598(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 251-252(1973).

The technology of machining plastic on metal-cutting machine tools is described which allows a 6- to 8-fold reduction of the time for fabricating lightguides for scintillation counters. (auth)

3296 ^{160}Tb, ^{182}Ta, AND ^{192}Ir AS EFFICIENCY CALIBRATION STANDARDS FOR Ge(Li) DETECTORS. Lavi, N. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 116: No. 3, 457-458(1974).

Accurately measured energies and relative intensities of the gamma rays emitted in the decay of ^{160}Tb, ^{182}Ta, and ^{192}Ir are recommended for use as calibration standards for Ge(Li) detectors. (auth)

3297 ON-LINE GAMMA-EFFICIENCY CALIBRATION USING FISSION-PRODUCED ^{138}Xe AND ^{138}Cs SOURCES. Achterberg, E.; Iglesias, F. C.; Jech, A. E.; Moragues, J. A.; Otero, D.; Perez, M. L.; Proto, A. N.; Rossi, J. J.; Scheuer, W. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Instrum. Methods; 116: No. 3, 453-455(1974).

The use of on-line collected ^{138}Xe and ^{138}Cs fission-produced sources is proposed for the on-line efficiency calibration of Ge(Li) detectors. The intensities of 33 gamma rays have been redetermined, by off-line measurements. (auth)

3298 THERMAL AND FAST NEUTRON MONITOR FOR USE IN A SUBCRITICAL FACILITY. Birstein, L. (Univ. of Chile, Santiago); Martinez, P.; Filevich, A.; Li, F. Nucl. Instrum. Methods; 116: No. 3, 615-616(1974).

A convenient mounting for a subcritical facility neutron monitor using a silicon detector is described. Slow and fast neutrons are detected by the ^{6}Li(n,α)^{3}H reaction and by proton recoil, respectively. (auth)

3299 DIAMETER EVOLUTION OF PROTON TRACKS IN A CELLULOSE NITRATE DETECTOR. Lueck, H. B. (Zentralinstitut fuer Kernforschung, Dresden). Nucl. Instrum. Methods; 116: No. 3, 613-614(1974).

The diameter evolution of etch pits initiated by protons with energies in a span of 300 to 1000 keV is described. The registration threshold of the cellulose nitrate detector used is about 700 keV. (auth)

3300 PARALLEL PLATE GAS SCINTILLATION PROPORTIONAL COUNTER FOR IMPROVED RESOLUTION OF LOW-ENERGY PHOTONS. Palmer, H. E.; Braby, L. A. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Instrum. Methods; 116: No. 3, 587-589(1974).

A transparent parallel plate gas scintillation proportional counter has been designed which provides improved resolution, more efficient use of counter volume, and better counting geometry than center wire or spherical anode counters. (auth)

3301 LIQUID SCINTILLATORS. Birks, J. B.; Poullis, G. C. (Univ. of Manchester, Eng.). pp 1-21 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Previous work in comparisons of liquid scintillator solutions is outlined, and the need for a new survey on liquid scintillators is given. Factors which determine the relative pulse height (RPH) of different scintillator solutions are listed. The RPH of a wide range of scintillator solutions was measured. The results are presented and discussed. (WHK)

3302 COLOUR QUENCHING IN LIQUID SCINTILLATION COINCIDENCE COUNTERS. ten Haaf, F. E. L. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). pp 39-48 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

A simple mathematical model for the response of liquid scintillation counters taking chemical and optical quenching into consideration is given. Pulse height spectra generated by the model for different conditions are compared with experimental data. (WHK)

3303 APPLICATION OF SOLID SCINTILLATORS IN HIGH PRESSURE RADIO COLUMN CHROMATOGRAPHY. Sieswerda, G. B.; Polak, H. L. (Univ. of Amsterdam). pp 49-59 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

A radiochromatography system was constructed in which the flow cell serves as a level detector to steer a fraction collector. Construction of the flow cell is described and the calibration and performance of the system are discussed. (WHK)

3304 HISTORY OF THE DEVELOPMENT OF THE MODERN LIQUID SCINTILLATION COUNTER. Rapkin, E. pp 61-100 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The development and evolution of commercial liquid scintillation counting systems is reviewed. Significant contributions by the various companies including changes leading to improved counting performance hence greater sensitivity and/or reduced counting time; those providing new convenience in instrument operation, sample handling, or data manipulation and presentation; and those which enhance instrument reliability are discussed. Information on liquid scintillation counter manufacturers is tabulated. (WHK)

3305 QUESTIONS REGARDING THE OCCURRENCE OF UNWANTED LUMINESCENCE IN LIQUID SCINTILLATION SAMPLES. Scales, B. (Imperial Chemical Industries Ltd., Alderley Park, Eng.). pp 101-107 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Some problems with background luminescence in liquid scintillation counting are discussed. Phosphorescence of vial caps, effects of temperature on different vial caps, a high background count in Triton X-100, chemiluminescence in dioxane due to peroxide formation, and luminescence from some glass injection tubes for GLC are discussed. (WHK)

3306 ACQUISITION AND HANDLING OF LIQUID SCINTILLATION COUNTING DATA. Spratt, J. L. (Univ. of Iowa, Iowa City). pp 245-265 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

A review on scintillation data processing is given. Topics include performance parameters, available instrumentation, quenching effects and quench correction, statistical considerations and computer programs for data handling, and factors influencing the data. (54 references.) (WHK)

3307 LIQUID SCINTILLATION COUNTING OF BIOLOGICAL SAMPLES USING EXTERNAL STANDARDIZATION AND AUTOMATIC DATA PROCESSING. Johnson, P.; Rising, P. A.; Rising, T. J. (Wellcome Research Labs., Beckenham, Eng.). pp 267-277 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Three different counters were used to compare standardization methods for a variety of samples with wide degrees of quenching. The samples are processed through one of the following counters: the Packard Tri-Carb model 3324, the Beckman model LS-200B or the latest Intertechnique model ABAC SL40-4K, all of which are fitted with a teletype for computer processing. It was found that the automatic external standard (AES) channels ratio method, which which is a built-in feature of the Beckman, was unsatisfactory for carbon-14 samples with counting efficiencies lower than 70%. Therefore, the counter was modified using the auxiliary power supply and fitting an external switch to drive the ^{137}Cs γ-source into position to obtain gross counts as required. Both the Tri-Carb and Intertechnique counters are fitted with an AES, but in addition the Intertechnique has its own built-in 4K computer. This gives the option with this counter of using either its own or our ICL 1903A computer which is used routinely for off-line applications. The AES process in the modified Beckman is different from that in the Tri-Carb and Intertechnique counters. In the modified Beckman, the samples are all counted and then the AES source is placed in position and each sample is counted again. In the Tri-Carb and Intertechnique, after the β-emission of each individual sample has been recorded, the γ-source is automatically brought out of its lead shielding and the total external standard counts are measured for that particular sample in a separate channel before counting the next sample. To overcome earlier troubles caused by variable positioning of the AES source, a magnetic latch system is now available for the Tri-Carb and has been fitted to the machine. Thus the geometry of counting varies in the three systems. (WHK)

3308 AUTOMATIC PROCESSING OF DATA FROM LIQUID SCINTILLATION COUNTERS ILLUSTRATED BY DRUG DISTRIBUTION STUDIES. Barber, H. E.; Bourne, G. R. (Univ. of Liverpool). pp 279-283 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

The liquid scintillation detector and data processing method for studying the distribution of ^{14}C- and/or ^{3}H-labeled drugs in animals are described.(WHK)

3309 DETERMINATION OF ABSOLUTE RADIOACTIVITY IN MULTILABELLED SAMPLES USING EXTERNAL STANDARDIZATION OF CHANNELS RATIO: A FORTRAN IV PROGRAM. Stanley, P. E. (Univ. of Adelaide, Glen Osmond, Australia). pp 285-291 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

A FORTRAN IV program for off-line analysis of liquid scintillation spectrometer data on a CDC 6400 computer is described. The program is for determining individual radioisotopes in multilabelled samples containing up to three species. Problems encountered in external standardization are also discussed. (WHK)

3310 EXPERIENCE IN OFF-LINE COMPUTER PROCESSING OF LIQUID SCINTILLATION COUNTING DATA. Deterding, J. H. (Shell Research Ltd., Chester, Eng.). pp 313-324 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

Research on liquid scintillation counting using off-line computer data processing at Thornton Research Center is described. (WHK)

3311 IMAGE-DISSECTING CHERENKOV DETECTOR FOR IDENTIFYING PARTICLES AND MEASURING THEIR MOMENTUM. Roberts, A. (to United States Atomic Energy Commission). US Patent 3,805,075. 16 Apr 1974. Filed Date 13 Mar 1973. 10p.

Charged atomic and subatomic particles in a beam are classified as to type and momentum range by a detector having a beam bender, a Cherenkov medium and a segmented optical system for generating electrical pulses corresponding to illumination of predetermined regions of Cherenkov circles. Analysis of the illuminated regions by electronic logic provides identifying signals for given particles and given ranges of momentum. (Official Gazette)

3312 REVIEW OF IEEE STANDARD TEST PROCEDURES FOR PHOTOMULTIPLIERS FOR SCINTILLATION COUNTING AND GLOSSARY FOR SCINTILLATION COUNTING FIELD. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 41 (Aug 1973). (ANSI-N-42.9-1972).

The standard is an updated compilation of tutorial information, definitions, measurement procedures, and a glossary of terms as applied to photomultiplier tubes used in the field of scintillation counting. The standard includes sections on electron resolution, time resolution and spurious pulse characteristics, thus making the document generally useful to a large variety of photomultiplier users. The Table of Contents which indicates the items and the areas covered is presented. (auth)

3313 DIGITAL OPTIMALIZATION DEVICE FOR DIRECTIONAL CHARGED PARTICLE MEASUREMENTS IN SPACE RESEARCH. Keppler, E.; Umlauft, G. (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 38-40(Aug 1973).

A method is described which allows for synchronization of periodically repeated spin-synchronous measurements with the spin-independent data readout cycle. The method is self-adapting insofar, as it adjusts itself to any spinrate, which the spacecraft may achieve. Permanent lock relative to the sun allows for directional measurements of particle fluxes in a coordinate system fixed relative to the sun without additional corrections. (auth)

3314 GAMMA CAMERA COLLIMATOR CONSIDERATIONS FOR IMAGING ^{123}I. McKeighen, R. E.; Muehllehner, G.; Mayer, R. A. (Searle Analytic, Inc., Des Plaines, IL). J. Nucl. Med.; 15: No. 5, 328-331(May 1974).

Line-spread functions and energy spectra for commercially produced ^{123}I were obtained on an Anger scintillation camera using three different collimators. Images of a thyroid phantom were also obtained using the same collimators. Although the 529-keV gamma ray of ^{123}I has a relative intensity of only about 1%, it and other high-energy but low-abundance gamma rays seriously degrade images by virtue of septum penetration through thin-wall collimators. Use of the pinhole collimator minimizes this problem. (auth)

3315 APPLICATIONS AND APPARATUS. pp 708-713 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Six papers on these topics are presented. They deal with the following subjects: analyses of the DSA measurements using a few-step stopping process; exploration of Z > N nuclei with multinucleon-transfer reactions; role of ethylene molecule clusters in a gas-jet radioactivity-transport system for neutron-induced reactions; a high-resolution energy loss spectrometer for electron scattering; applications of thin-film detectors to detection of energetic heavy particles; and triple gamma angular correlation studies of the radiations from the decay of ^{192}Ir. (RWR)

3316 GAS XENON SCINTILLATOR FOR THE REGISTRATION OF SOFT X-RAYS. Alikhanyan, A. I.; Kankanyan, S. A.; Oganesyan, A. G.; Tamanyan, A. G. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 3, 228-231(1973). (In Russian).

The results of experimental investigations of xenon gas scintillators are given. It is shown that such scintillators can be used for the registration of soft x-rays instead of the NaI(Tl), semiconductor detectors, and proportional counters. (auth)

3317 NUKLEARE ELEKTRONIK. (Nuclear Electronics). Abend, K.; Vogelsang, E. Thiemig-Taschenbuecher, Band 47. Munich; Verlag Karl Thiemig (1973). 148p. DM 14,80.

The characteristics of the most important electronic instruments and electronic components used in the nuclear area are compiled and discussed. The instruments and components considered are radiation detectors, amplifiers for detectors, pulse-forming circuits, pulse amplitude converters, timing circuits, digital circuits, particle counters, particle spectrometers, position-sensitive detectors, and on-line computers. (JSR)

3318 REGISTRATION OF FISSION FRAGMENTS BY ORGANIC PLASTIC SCINTILLATORS OF DIFFERENT THICKNESSES. Arifov, U. A.; Galyamov, G. Z.; Kogan, V. I.; Pikul, V. P. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 64-66(1973). (In Russian).

Solid solutions of 2% terphenyl in polystyrene + 0.02% POPOP was dissolved in toluol and deposited on glass. The sensitivity of the plastic scintillator to fission fragments was measured. The measurements showed that the best results were obtained at film thicknesses of 15 to 20 μ. At thickness below 10 μ the registration efficiency sharply decreased. At thickness above 30 μ there is an increase of the registration of γ rays and α particles. (JSR)

3319 MULTIPLEX SYSTEMS FOR RECORDING PARTICLES (REVIEW). Soroko, L. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1297-1309(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 7-19(1973).

The purpose of the review is to focus the attention of experimenters on new possibilities which are provided by multiplex particle-recording systems, i.e., systems whose subject of observation is not the actual desired functional dependence but its code-integral transform. Such recording systems are necessary when the accuracy of the measurements is determined not only by the statistics of the useful events but also by the interferences created by external experimental conditions, particle detector noises, and the drift of the parameters of the measurement equipment. Multiplex systems allow the detection of more subtle effects in the experimentally observed functional dependences than can be detected by remaining within the framework of the classical logic of performing the experiment. The synthesis theory and the principle of operation of multiplex particle-recording systems are expounded in the review. (auth)

3320 MEASUREMENT OF THE CHARACTERISTICS OF PLASTIC SCINTILLATORS. Airapetov, E. A.; Kulikov, V. V.; Tashchyan, A. A.; Khaldybanov, V. Kh. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1368-1370 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 65-67(1973).

Results are presented of measurements of the deexcitation time, the relative luminescence yield, and the light reduction for three types of Soviet scintillators. (auth)

3321 SENSITIVITY OF COUNTERS WITH ^{3}He IN HYDROGENOUS MEDIA WITH AN AIR GAP. Bulanenko, V. I.; Frolov, V. V.; Charychanskii, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1360-1362(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 59-60(1973).

Computational and experimental investigations of the dependence of the sensitivity of cylindrical ^{3}He thermal-neutron counters on the air gap between the lateral surface of the counter and the surrounding hydrogenous medium are presented. It is shown that in the presence of an air gap the sensitivity of the counters to thermal neutrons increases. (auth)

3322 INTRINSIC RESOLVING TIME OF DIAMOND NUCLEAR-RADIATION DETECTORS. Kozlov, S. F.; Likhosherstov, V. N. (Inst. of Nuclear Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1363-1364(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 61-62(1973).

A description is given of an experimental installation for measuring the intrinsic resolving time of diamond detectors as a function of their thickness, energy resolution, bias voltage, and the type of ionizing radiation, and the results of the measurements are presented. (auth)

3323 CHANGE IN THE TRANSPARENCY OF SCINTILLATORS DUE TO THE ACTION OF X-RAY PULSES. Lyutin, V. D.; Tochilovskii, G. P.; Uvarov, N. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1371-1373(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 67-69(1973).

An installation is described for measuring the dependence of the transparency of scintillation plastics on the dose of pulsed x radiation and on the elapsed time after irradiation. It is shown that the loss of transparency during the first tens and hundreds of microseconds after irradiation is 100 to 1000 times greater than the loss of transparency determined during measurement with weak sources having constant intensity. After the action of a powerful x-ray pulse having a length ~1 μsec and a dose ~7×10^3 rad, the scintillator restores its transparency over a period of several minutes. (auth)

3324 JOINING OF A SCINTILLATOR TO A LIGHTGUIDE. Agan'yants, A. O.; Kazaryan, G. Kh.; Khudaverdyan, A. G. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1374(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 69-70(1973).

A method is described for gluing scintillators together with lightguides, which was successfully realized due to the compensation of the moments of the acting forces and the weights of the joined components. (auth)

3325 INTENSITY OF THE LIGHT FLUX INCIDENT ON A PHOTOCATHODE FROM A DISTANT SCINTILLATOR. Mochkaev, V. A.; Kuzyanov, V. V.; Uvarov, N. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1375-1377(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 70-72(1973).

The dependence of the intensity of the light flux incident on the photocathode on the distance between the scintillator and the photocathode was determined experimentally along with the intensity distribution of the incident light over the photocathode diameter. The measurements were carried out on scintillation plastic (polystyrene + 2% PPP + 0.06% POPOP) having a height of 1 to 50 mm under irradiation by γ quanta from ^{60}Co at distances ranging from 0 to 500 mm. The experimental data are evidence of the absence of any substantial directivity of the light radiation. (auth)

3326 DETERMINATION OF RADON IN AIR. Auxier, J. A.; Perdue, P. T.; Shinpaugh, W. H.; Thorngate, J. H. (to United States Atomic Energy Commission). US Patent 3,805,070. 16 Apr 1974. Filed date 6 Jul 1973. 6p.

This invention relates to a device and method for measuring the amount of radon present in the air. A silicon diode detector system operates in helium at atmospheric pressure, and an alpha spectra is obtained that can be analyzed for the radon activity. The invention facilitates radon concentration measurements in the many widely scattered localities in the biosphere where these measurements are of interest, such as in uranium mines, coal mines, and in the lower atmosphere. (Official Gazette)

Radiation Dosimeters

Refer also to abstracts 2493 and 4076.

3327 (AD-769714) HIGHLY RESPONSIVE, FERROELECTRIC-SENSED CALORIMETER FOR NEUTRON ENERGY DEPOSITION. Klopcic, J. T.; Swanson, D. L.; Sefcik, J. D. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Sep 1973. 50p. (BRL-1670). NTIS $3.00.

A lumped-parameter analysis is presented of the thermal and electrical response of a calorimeter which employs an electroded piece of ferroelectric ceramic as the temperature sensing element. This analysis is applied to a prototype calorimeter constructed for this project and predicts the measured response of 0.00009 volts/RAD(Cu). The analysis and prototype further showed that the expected sensitivity of the calorimeter, having optimized certain parameters, is better than 0.1 RAD(Cu)/min. The results are applied to measurement of energy deposition by neutrons, and the results of tests in an intense gamma-ray environment are used to design a calorimeter for use in mixed radiation fields. (auth)

3328 (CONF-720724-P1, pp 565-577) HEAVY COSMIC-RAY EXPOSURE OF APOLLO 14 ASTRONAUTS. Benton, E. V.; Henke, R. P. (Univ. of San Francisco). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

On Apollo 14 as on earlier missions, the individual astronauts' high Z particle exposure was measured by means of Lexan foils. The foils are located in the passive dosimetry packs carried on the chest, thigh, and ankle of each astronaut. Counts of tracks from the heavy, $Z \geq 8$ cosmic-ray nuclei yielded an average exposure of 8.9 ± 0.4 tracks/cm^2 for the duration of the mission. These measurements, initiated with the first Lunar orbiting mission, Apollo 8, have shown a consistant increase in the measured high Z particle exposure. The Apollo 14 exposure is a factor of about 2 to 3 times higher than that measured on Apollo 8. This increase is attributable to the increased duration of the latter missions and to the increased galactic cosmic-ray flux resulting from the decrease in solar modulation. On the basis of measurements the stopping particle density as an integral Z distribution, the particle integral LET spectrum, and the fractional cell loss are calculated. (auth)

3329 (CONF-720724-P1, pp 578-590) HEAVY COSMIC-RAY EXPOSURE OF APOLLO 15 ASTRONAUTS. Benton, E. V.; Henke, R. P. (Univ. of San Francisco). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The measured exposure of the Apollo 15 astronauts to the high-LET ($LET_{350} > 0.15$ MeV/μ) radiation component due to particles with atomic numbers, $Z > 8$ is presented. As in earlier missions

the measurements utilized Lexan nuclear track detectors, which serve as threshold detectors for the registration of the highly-ionizing particles. Particle stopping densities are given as an integral Z spectrum. The integral LET spectrum is given, and from it the fractional cell loss is computed. On Apollo 15 a mission average fluence of 12.0 ± 0.5 particles/cm^2 with $LET_{350} > 0.15$ MeV/μ was recorded. This is a 63% increase over the Apollo 14 mission average, indicating that the modulation of the cosmic-ray beam by the solar magnetic field is still diminishing as the solar cycle approaches a minimum. Significant differences in the HZE particle exposures were observed between the different detector packets. The CM pilot's exposure was found to be significantly lower than that of the Commander and the LM pilot. As in the previous flight, the highest exposure was recorded by the detectors located in the film bag. (auth)

3330 (CONF-720724-P2, pp 284-304) COSMIC RAY DOSIMETRY ON BOARD THE CONCORDE PROTOTYPE. Kaiser, R. (Laboratoire de Physique Corpusculaire, Strasbourg). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The experimental technique used for the measurement of the cosmic ray charged particle and neutron doses on board the Concorde is described in detail. The measurements were made with stacks of nuclear emulsions and plastic detectors. The results obtained are tabulated and compared with those obtained by the English. These results showed that the charged particle and neutron doses are weak. The technique used is satisfactory for charged particles but modifications are necessary for neutrons. (JSR)

3331 (CONF-720724-P2, pp 333-339) APPLICATIONS OF SOLID TRACK DETECTORS TO DOSIMETRY. Personnel Dosimetry and Spatial Dosimetry. Francois, H. (CEN, Fontenay-aux-Roses, France). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The particular problems of personnel dosimetry are briefly outlined. The application of solid track detectors to the dosimetry of neutrons and Rn is discussed. (JSR)

3332 (CONF-720724-P2, pp 355-361) TRACKS OF CHARGED PARTICLES FORMED IN POLYMER FOILS BY FAST NEUTRONS; IMPLICATIONS TO FAST NEUTRON DOSIMETRY. Spurny, F. (Lab. for Radiological Dosimetry, Prague). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In neutron dosimetry it is generally supposed that the tracks visible in polymer foils after exposure to fast neutrons are due to α-particles and/or carbon and oxygen recoils. The possibility of registration of recoil protons remains an open question. The aim of this work was to distinguish the contribution of these particles to the total number of visible tracks formed after the irradiation by fast neutrons. Preliminary experiments are presented. The registrability of α-particles in cellulose derivatives and their contribution to the total number of tracks that are visible after the irradiation by fast neutrons from a RaD-Be source are studied. Some indications on the possibility of an automatic evaluation are also given. (WHK)

3333 (CONF-720724-P2, pp 362-377) USE OF CELLULOSE NITRATE FOR FAST NEUTRON DOSIMETRY. Dragu, A.; Nicolae, M. (Inst. of Atomic Physics, Bucharest). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Due to the fact that solid state track detectors have some advantages compared with nuclear emulsions, they seem to be useful for fast neutron dosimetry. The two main processes useful in neutron detection are examined. The elastic scattering of neutrons by the carbon, nitrogen and oxygen nuclei allows the recording of the recoil nuclei. The efficiency for a Pu-Be source is 10^{-5} track per neutron. The second important process which is taken into account is the (n,α) reaction with the C, N, O nuclei. For the same spectrum the computed efficiency is 8.10^{-6} track per neutron. The experimental results are in sufficiently good agreement with the theoretical computations to consider the cellulose nitrate detectors as a good fast neutron integrating device, for energies below 10 MeV and for usual neutron sources of known spectrum. (auth)

3334 (CONF-720724-P2, pp 378-385) PRACTICAL PROBLEMS OF USING KODAK PERSONAL NEUTRON MONITORING FILMS TYPE A IN ROUTINE PERSONNEL DOSIMETRY. Jasiak, J.; Musialowicz, T. (Central Lab. for Radiological Protection, Warsaw). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

For routine neutron monitoring of persons working at various nuclear installations, such as, reactors, cyclotron, accelerators, neutron generator and with beryllium neutron sources, Kodak Personal Neutron Monitoring Films type A have been used. A film is placed between 1.0 mm thick cadmium sheets covering one half of its area and sealed in a polyethylene holder. The method based on counting of recoil proton tracks in nuclear emulsion is described. (WHK)

3335 (CONF-740608-3) SPARK COUNTING OF NEUTRON-INDUCED RECOIL PARTICLE TRACKS IN POLYMERS. Becker, K.; Razek, M. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 4p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

This study demonstrated that the efficient automatic spark counting of recoil particle tracks in thin polymer foils, such as cellulose nitrate and polycarbonate, is possible if the foils undergo extended etching to the point where electric breakdown begins to occur even in unexposed foils. The background spark count of an overetched, unexposed foil is increased by exposure of a commercial cellulose nitrate foil (Kodak-Pathé LR 115 strippable) to fission neutrons. There is, however, no well-defined plateau in the spark-count vs. voltage diagram and the count increases during repeated sparkings of the same foil. Optimum etching conditions have to be established separately for each foil by determining the signal-to-background ratio as a function of sparking voltage and etching time. The sensitivity increases with increasing foil sensitivity and neutron energy, but even in less sensitive Kimfol polycarbonate foils, 3 rad of fission neutrons produce a count substantially higher than background. The count was consistently higher in Teflon-covered foils than in polyethylene-covered ones for different foil materials and neutron energies, indicating that no recoil proton tracks are sparked. A similar acceleration in electric breakdown is produced by very high ($\sim 10^4$ to 10^6 R) gamma radiation doses. This does, however, not interfere with most dosimetric applications of this technique. The method shows promise in personnel dosimetry and for special studies such as depth-dose measurements and bone-tissue interface dosimetry. (WHK)

3336 (LA-UR-74-622) NEUTRONS FROM A HIGH ENERGY PROTON BEAM STOP. Perry, D. G.; Barr, D. W.; Gilmore, J. S.; Dudziak, D. J.; Simmons, M. L.; Russell, G. J.; Seeger, P. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 8p. (CONF-740402-24). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The LAMPF beam stop was used as a neutron source. A carbon beam stop with a 497-MeV incident proton beam was studied. An experiment to measure the total neutron flux and the neutron spectrum has been completed. The total neutron flux is 5.8×10^{12} n/cm^2. Possible high energy neutron reactions have been examined for their suitability as threshold detectors for use in dosimetry measurements. (auth)

3337 (SSI-1974-8) SIGNAL TO NOISE RATIOS IN RADIATION DOSIMETRY USING SEMICONDUCTORS. Larsson, S. A.; Bengtsson, L. G. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

Signal-to-noise ratios are becoming important in radiation dosimetry when low radiation doses are to be measured using semiconducting diodes to detect either the ionizing radiation itself or the light emitted from a radiation sensitive transducer. The signal due to ionizing radiation in the diode is in the first case the primary signal but in the second case an unwanted by-product, the effects of which should be minimized. In both cases the noise contributions arise from the diode itself as well as from the amplifier used. Factors influencing the noise and the sensitivity of the semiconducting detectors are discussed, including biased and unbiased operation of the photodiode, and phase sensitive detection of the signal information. It was found that in most applications, factors other than the signal-to-noise ratio will govern the selection of the mode of operation. (auth)

3338 READER FOR THERMOLUMINESCENT DOSIMETERS. Jones, A. R.; Richter, W. F. (to Atomic Energy of Canada Ltd.). Canadian Patent 930,482. 17 Jul 1973.

Improved control of temperature in the reading of thermoluminescent personal dosimeters is achieved by placing the thermoluminescent material on a heated block, with a special thermocouple above it, on the same side as the optical system. Special electronic circuits ensure that a reading of emitted light is not taken until the thermoluminescent device is hot enough. (CA)

3339 TLD TRANSIT DOSE. Caruthers, L. T.; Shepard, N. C. III. (North Carolina State Univ., Raleigh). Health Phys.; 26: No. 4, 367-368 (Apr 1974).

Discrepancies of up to 25% were noted between TLD measurements made in-house at North Carolina State University and those obtained from packages of dosimeters contracted to be read by a midwestern company. It has been found that these discrepancies are due to flight doses obtained from high altitude flying and co-shipment of radioisotopes. Modification of the monitoring program now measures the unwanted radiation dose. A figure of 2.7 mr transit dose was obtained with an environmental dose of 11 mr. (UK)

3340 FACT, FASHION, AND/OR FANTASY IN FAST NEUTRON PERSONNEL DOSIMETRY. Gold, R. (Joint Center for Graduate Study, Richland, Washington). Health Phys.; 26: No. 4, 366-367(Apr 1974).

The ability of any fast neutron personnel dosimeter depends upon the entire domain of time-dependent neutron energy spectra encountered within the environment of interest. Although fashionable research directions would imply that fast neutron personnel dosimetry simply factors into a product of related problems, each of which can be studied independently, this is not the case. These problems are in fact, non-separable. This non-separable dependence on the fast neutron environment is established in this note. It is not sufficient to advance concepts for new or novel fast neutron dosimeters and yet fail to provide the necessary objective and quantitative evaluation of these methods. (UK)

3341 MEASUREMENT OF X-RAY QUALITY USING TLD. Bushong, S. C.; Gray, P. M.; Prasad, N.; Glaze, S. A. (Baylor Univ., Houston, TX). Health Phys.; 26: No. 4, 358-360(Apr 1974).

From Health Physics Society seventeenth annual meeting; Las Vegas, Nevada (11 Jun 1972).

Efforts to show that thermoluminescent dosimetry techniques are applicable to the measurement of x-ray quality in diagnostic radiology are reported. Groups of three LiF and $CaF_2:Dy$ dosimeters were exposed simultaneously to 15 different photon beams of effective energy ranging from 18 to 1250 keV. An orthovoltage x-ray therapy machine and a superficial machine provided eight and five of the experimental beams respectively. A ^{137}Cs and a ^{60}Co teletherapy unit were also used. No attempt was made to determine the absolute exposure received by the dosimeters since the purpose of this investigation was to estimate radiation quality with the use of simultaneously exposed TLDs. Four experimental irradiations at each of the 15 different photon energies were conducted and the averages of these results are shown. (UK)

3342 DEVELOPMENT OF A SYSTEM FOR THE RADIATION DOSIMETRY OF REACTORS. Kovaleva, E. P.; Petryaev, E. P.; Kalyazin, E. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 4, 16-20 (1973). (In Russian).

The dependence of radiolysis of methanol, ethanol, and their aqueous solutions on dosimetric parameters is considered; these systems are being considered as dosimeters for radiation technology in nuclear reactors. (auth)

3343 THERMALLY STIMULATED CURRENT RADIATION DOSIMETER. Mitchell, J. P.; DeNure, D. G. (Bell Labs., Whippany, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 67-76(Oct 1973).

Thermally stimulated current (TSC) radiation dosimeters were made from the borosilicate sealing glass used to make transistor headers. These dosimeters, consisting of a metal-glass-metal sandwich structure with electrodes (Kovar or Nicoseal) bonded to the glass with glass-to-metal seals, were experimentally studied to determine how they operate, and how they can be used in the design of a practical dosimetry system. Exposure to ionizing radiation (^{60}Co-gamma or 175 kV x rays) created trapped charge in the glass. Heating the dosimeter from one side, so as to produce a temperature gradient across the glass, released the trapped charge and produced a TSC which was observed as a TSC vs. temperature glow curve. The integrated charge output from a dosimeter was proportional to the radiation dose. A simple model is proposed to explain the origin of the TSC and the qualitative behavior of this current. (WHK)

3344 SILICON DIODES WITH A RADIATION MARGIN IN THE MRAD REGION FOR PULSED DOSIMETRY OF PROTONS. Dmitrievskii, I. M.; Kleinbok, Ya. L.; Lapshin, V. K.; Lomanov, M. F.; Myagchenko, K. A.; Frolov, V. V. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1365-1367(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 63-64(1973).

The criteria are established for choosing silicon semiconductor diodes for pulsed proton dosimetry which have a radiation margin in the Mrad region. It is shown that when these criteria are fulfilled it is possible to use the method of measuring the dose according to the current induced by the radiation. The criteria for choosing the diodes were substantiated experimentally on the medical biological proton beam of the synchrotron of the Institute of Theoretical and Experimental Physics. It was determined experimentally that a 2D503A diode has a radiation margin of at least 2 Mrad. (auth)

3345 DETERMINATION OF THE CALIBRATION CHARACTERISTICS OF EXTERNAL IRRADIATION DETECTORS. Simoen, J. P. (CEN de Saclay, Gif-sur-Yvette, France). pp 269-276 of Seventh National Congress of the Health Physicist's Association, Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The correct utilization of an external irradiation detector demands a knowledge of certain characteristics of the apparatus used: the response as a function of the energy of the radiation; the response as a function of the angle of incidence; the response as a function of the dose rate; the correction factor. Appropriate sources are required to determine these characteristics. A problem encountered is the choice of the true value of the parameter measured (reference value). In radioprotection work, the reference value is the dose absorbed in tissues at a given depth (7 or 300 mg cm^{-2}). In the case of photons, the true value of this parameter is deduced either from the exposure (use of a reference exposure meter, or exposure calibrated sources) or from the dose absorbed in air at a depth of 300 mg cm^{-2} (TC-5-300 chamber of the SACLAY radioprotection service). The coefficients necessary to convert the magnitudes measured into doses in tissues were calculated for photon energies between 10 keV and a few MeV and are presented in graphical form. (FR)

3346 pH-DEPENDENCE OF HALOGENATED HYDROCARBON DOSEMETERS. Wolschendorf, K. (Univ., Kiel). Atomkernenergie; 23: No. 1, 13-18(1974). (In German).

Aqueous solutions of organic halogen compounds are sensitive liquid dosimeter systems. Their most important advantage is the comparatively high yield and the ease with which the final radiolysis product can be detected. One of the disadvantages of these systems, however, is the non-linearity of the dose-effect curve. The present experiments using the one-phase chloroform-water system were carried out to clarify the reaction mechanism to which this non-linearity is due. It is shown that the dose-effect curve cannot be solely explained by a superposition of simple parallel and series mechanisms. From the results of the pH-dependence it is concluded that the non-linearity can be referred to a feedback reaction of the acid with some intermediates. A reaction model is presented which includes this mechanism and the dose-effect curve of which exhibits the same non-linear behavior as that of the measured curves. (GE)

3347 INFLUENCE OF CHEMICAL COMPOSITION ON THE COLOR CHANGES AND ITS SHARPNESS IN A THRESHOLD DOSIMETER FOR THE MRD RANGE. Huebner, K. (Technische Univ., Dresden). Radiochem. Radioanal. Lett.; 17: No. 1, 41-54 (10 Apr 1974). (In German).

After irradiation with ionizing radiation the system methyl orange–polyvinyl alcohol–chloral hydrate–borax shows a sharp discoloration from yellow to red at a determined dose in the Mrd range. Therefore, it is useful as a threshold dosimeter. The dose of discoloration and the sharpness of this discoloration depend on the concentration of chloral hydrate and of borax. This dependence was investigated. A possible mechanism for the discoloration is discussed. (auth)

3348 SOLID STATE DOSIMETRY: 10 YEARS OF ROUTINE USE AND DEVELOPMENT. Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 16: No. 2, 71-81(Feb 1974). (In German and English).

The experience and results obtained in the practical use of solid state dosimeters in personnel monitoring are reported. Besides phosphate glass and thermoluminescence dosimeters, activation detectors, non-photographic nuclear track detectors, and albedo neutron dosimeters are discussed. The use of appropriate solid state detectors results in a marked improvement of routine monitoring, with possibilities of cost-reducing long-term dosimetry and in an optimum measuring accuracy in the field of accident dosimetry. (GE)

3349 ELECTRONIC EQUIPMENT FOR MEASURING SMALL CURRENTS. Dosimetry Applications Using Classical Ionization Chambers and Dielectric Liquid Ionization Chambers. Charge Measurement Applications for Aerosol Studies. Bouet, J.; Chuiton, R.; Prigent, R. (CEN, Fontenay-aux-Roses, France).

pp 195-204 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The electronic equipment presented enables small currents (of the order of 10^{-13} to 10^{-15}A) to be measured. The instrument has a dynamic range of 10^4 (full scale deflection). It can easily be adopted to detection equipment having various different characteristics and consists of a basic amplifier unit and an accessory power supply. A variable stabilized 5000 volt power supply can be incorporated to operate dielectric liquid ionization chambers. Circuit matching is effected using a portable preamplifier and 50 meters of cable. The equipment offers two distinct possibilities: current measurements (absorbed dose rate measurements); integrated current measurements (absorbed dose). A two-way switch on the equipment is used to select the type of operation desired. The equipment weighs about 5 kg and has the following dimensions: 330 × 170 × 110 mm. A preamplifier (100 × 65 × 65 mm) is plugged directly into a special housing provided for this purpose. The equipment is thus very easily transported and simple to use. (FR)

3350 APPLICATION OF DOSIMETRY AND THE NORMALIZATION OF CALIBRATION METHODS TO RADIOPROTECTION. Lasseur, C.; Poutesux, M. (CEN, Fontenay-aux-Roses, France). pp 153-165 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

External irradiation dosimetry is reviewed. The magnitudes of the dosimetry parameters and the recommendations of the CEA Radiation Protection Services are cited. Various methods are compared, the importance of normalization in radioprotection dosimetry being emphasized. (FR)

3351 ELECTRONIC METHODS FOR THE REGISTRATION OF RADIATION-INDUCED REACTIONS. Schwarze, H.; Wolschendorf, K. (Univ., Kiel). Atomkernenergie; 23: No. 1, 19-22 (1974). (In German).

The linearity of the characteristic of a liquid dosimeter system is an important criterion for its applicability. Several dosimeters of high sensitivity, particularly saturated aqueous solutions of halogenated hydrocarbons, exhibit a nonlinear dose-effect curve which is due to the complicated reaction mechanisms involved. For a better identification of these mechanisms the dose-effect curve of the system in question has to be recorded with an accuracy as high as possible. Therefore in most cases those methods are preferred which enable an immediate conversion of the radiation induced change in concentration into an electrical signal (e.g. conductivity, optical extinction). There are several different procedures for detection of this electrical signal the most important of which are presented. A comparison of these methods is made and their applicability in pulse radiolysis is discussed for different ranges of time. (GE)

3352 AUTOMATIC RADIATION EXPOSURE EVALUATION SYSTEM, BASED ON THERMOLUMINESCENCE, FOR PERSONNEL AND ENVIRONMENTAL MONITORING. Schulz, H. J. (Harshaw Chemie GmbH, Wermelskirchen, Ger.). Kerntechnik; 16: No. 2, 58-62(Feb 1974). (In German and English).

After the promulgation of the X-ray Ordinance of Jan. 9, 1973, the number of persons to be controlled has drastically increased. An automatically working evaluation system allows the reading of a great number of dosimeters and the storage of the data in a very short time. The relation between dosimeter and controlled person is effected by the system as well as the acoustic and optic display of values exceeding a preselected dose. The described system is suitable for personnel dosimetry, environmental supervision, and entry-exit registration of persons working in control regions. Some results are shown. (GE)

3353 PERSONNEL DOSIMETRY IN TRITIUM PRODUCING INSTALLATIONS. Pele, J. M. (Centre de Marcoule, Bagnols-sur-Ceze, France). pp 115-120 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French)

From seventh national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The equipment, monitoring methods, and personnel dosimetry techniques used in installations producing tritium are examined in the light of information compiled over a period of 4 years on protection against tritium. Tritium is not very toxic and is relatively easily detected. Difficulties, however, arise from its newness and the lack of information available on its noxiousness, i.e., chemical nature of the contaminations, diffusion of tritium, decontamination of materials, and the confinement of tritiated materials. The work undertaken has led to considerable advances in the fields of individual dosimetry and the monitoring of installations. (FR)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 2600, 4109, 4113, and 4998.

3354 (BARC/I-117) ELECTRONICS OF SERVO-CONTROLLED MOESSBAUER SPECTROMETER. Patwardhan, P. K.; Indurkar, V. S.; Khandwe, A. L. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 5p. INIS.

The design of servo controlled Moessbauer spectrometers is based on the constant acceleration and the constant velocity modes of operation. Electronic methods employing velocity-servo feedback are used advantageously to generate constant, linearly increasing or sinusoidally varying velocities. An electromechanical vibrator is used in conjunction with a velocity transducer for velocity feedback which controls the instantaneous velocities accurately. The spectrometer was subjected to a test using ^{57}Co as source and natural iron foil as absorber. In the absorption spectrum obtained, a magnetic hyperfine splitting is observed which shows six well resolved dips with excellent percentage absorption ratio. The full width at half maxima was observed to be better than 0.4 mm/sec for the outermost dips. (INIS)

3355 (CONF-720724-P2, pp 55-58) FISSION FRAGMENT ENERGY SPECTRUM DETERMINATION BY SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Durrani, S. A.; Fremlin, J. H. (Univ. of Birmingham, Eng.). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Various glass track detectors were studied for their spectral response to a normally incident beam of ^{252}Cf fission fragments by measuring the diametric distribution of the resulting etch pits. Results are presented graphically. (WHK)

3356 (EGG-1183-1497) ARMS: SENSITIVITY FOR ISOTOPE LOCATION AND IDENTIFICATION. Technical Memo No. L-242. Stuart, T. P. (EG and G, Inc., Las Vegas, Nev. (USA)). 23 Nov 1970. 23p. Dep. NTIS $4.25.

The ARMS aircraft contains an array of fourteen 4-in. × 4-in. NaI crystals for γ-ray detection. The signals from the photomultipliers viewing these crystals are summed and pulse-height analyzed with electronic gear carried on the aircraft. Count rate meters can be adjusted to continuously monitor any portion of the spectrum. These systems are often used for identification of unknown activity and occasionally for location of lost sources. Radioactivity necessary for identification or location is estimated. The response of the detection system to point sources and to distributed sources (both airborne and terrestrial) are considered as a function of photon energy. Due to the arbitrariness of assumed detectability criteria, results derived should be considered as approximate and subject to experimental verification. (WHK)

3357 (HMI-B-131) FIT PROGRAM FOR MOESSBAUER SPECTRA. Morfeld, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kernchemie und Reaktor). Mar 1974. 63p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

A computer program for the evaluation of Moessbauer absorption spectra measured in the time mode is presented. With small changes, spectra measured in the velocity mode can also be processed. The mathematical methods used in the program are described. Each subprogram is described in detail. An example is given of the data imput and the printout of the results. The program is written in Fortran IV but can be used in other computer languages with some alteration. The program is given. (JSR)

3358 (ITEF-18) CALCULATION OF THE PARAMETERS OF A MAGNETIC β SPECTROMETER WITH A DEFLECTING SYSTEM IN THE FORM OF A RECTANGULAR SPOOL. Tarasov, E. K.; Tret'yakov, E. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 59p. (In Russian). Dep. NTIS (U.S. Sales Only) $6.00.

The trajectories of electrons in fields formed by a linear conductor with a circular cross section placed at a distance r_0 from the axis were calculated. The luminosity and image form of the linear source were obtained for three pulse values By use of a ½ gap in these systems resolving capacities of $\Delta p/p = 3 \times 10^{-4}$ can be obtained with a luminosity of 1% and a source area of 1.5×10^{-4} r_0. (tr-auth)

3359 (JAERI-M-5364) PROGRAM FOR SIMULTANEOUS ON-LINE CONTROL OF TOF AND TRIPLE-AXIS NEUTRON SPECTROMETERS. Funahashi, S. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 82p. (In Japanese). NTIS (US Sales Only).

A simultaneous on-line minicomputer control system for the two types of neutron spectrometers installed at the JRR-2 was completed and is operating satisfactorily. Software for this system is described to assist those who operate it. Special care is taken in order to make the two neutron spectrometers compatible. The program is written in the assembler language for HITAC-10. The CAMAC system, prepared by the electronics shop of JAERI, is used to connect the HITAC-10 minicomputer to the spectrometers. The present report also serves as a reference for those who will program for a minicomputer on-line control system in assembler language. (auth)

3360 (N-73-17576) ELECTRON/PROTON SPECTROMETER CERTIFICATION DOCUMENTATION ANALYSES. Gleeson, P. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). 1972. 458p. (NASA-CR-128705; EPS-779). NTIS $24.50.

A compilation of analyses generated during the development of the electron-proton spectrometer for the Skylab program is presented. The data documents the analyses required by the electron-proton spectrometer verification plan. The verification plan was generated to satisfy the ancillary hardware requirements of the Apollo Applications program. The certification of the spectrometer requires that various tests, inspections, and analyses be documented, approved, and accepted by reliability and quality control personnel of the spectrometer development program. (auth)

3361 (N-73-17577) DESIGN CERTIFICATION REVIEW ASSESSMENT REPORT. Electron/Proton Spectrometer. (Lockheed Electronics Co., Webster, Tex. (USA)). 1972. Contract NAS9-11373. 96p. (NASA-CR-128704). NTIS $7.00.

The characteristics of the electron-proton spectrometer developed for the Skylab program are presented. The spectrometer is externally mounted on the Skylab module complex and provides omnidirectional measurement of electrons and protons which result from solar flares or enhancement of the radiation belts. The data are applied to the determination of relative biological effectiveness factors as a safety factor for manned space flight. (auth)

3362 (UCRL-75519) Ge(Li) AND FIDLER IN SITU SPECTROMETRY WITH EMPHASIS ON AMERICIUM. Roth, S. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1974. 19p. (CONF-740212-2). Dep. NTIS $4.00.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

The results of in situ gamma spectrometry, especially on measurements of americium, performed principally at the USAEC Nevada Test Site are reported. With the predicted increase in dependence upon nuclear reactors, and the desired clean-up of contaminated areas, the Biomedical Division is attempting to design more sensitive gamma ray detectors for measuring terrestrial americium and plutonium. Because the associated gamma radiation from plutonium decay is extremely weak, we are primarily interested in the 60 keV photon from ^{241}Am (.36 γ/dis), a long half-life daughter (433 years) of ^{241}Pu. We hope to infer the ^{239,240}Pu concentration from knowledge of the ^{241}Pu/^{241}Am ratio, measured by soil sampling and wet chemistry, and the known ^{239,240}Pu/^{241}Pu ratio of the source material. In highly contaminated areas, the ^{238}Pu contamination can be assessed directly by measuring the 129 keV (6.2×10^{-5} γ/dis), 375 keV (1.58×10^{-5} γ/dis) and 414 keV (1.51×10^{-5} γ/dis) gamma radiation. The characteristics of the two detectors are given. The 70 cm^3 Ge(Li) detector is of the closed end coaxial design, specially mounted to afford a low attenuation path for incident gamma rays. The FIDLER (Field Instrument for Detecting Low Energy Radiation) is a detector in which a $\frac{1}{16}$ inch thick, 5 inch diameter sodium iodide crystal (NaI(Tl) is coupled by a quartz light pipe to a selected 5 inch RCA 8055 photomultiplier tube. The detector assembly is mounted within a $\frac{5}{32}$ inch thick stainless steel can and has a 0.010 inch thick beryllium entrance window. The general system consists of electronics and support equipment mounted within a completely mobile van. The data are processed in a 4096 channel pulse height analyzer that permits some immediate data reduction. They are recorded on magnetic tape, which is then returned to Livermore for computer processing. (auth)

3363 SECONDARY ELECTRON SPECTROMETER (SES) WITH PREACCELERATION. Steiner, K.; Baumgartner, W. (Eidgenoessische Technische Hochschule, Zurich). Z. Angew. Math. Phys.; 24: No. 3, 455-457(25 May 1973). (In German).

The measurement of the energy distribution of electrons with a low energy brings special problems. A secondary electron spectrometer (SES) is described that has the following advantages: measurement of the energy spectrum in reflexion and transmission, as well as of photo-electrons with a resolution of at least 1% with a minimum of electrical and magnetic disturbance; vapor deposition, and in situ measurement of layers in ultrahigh vacuum conditions. The design and function of the spectrometer is explained and illustrated. Results of the measurement with secondary electrons emitted from tungsten are also shown. (INIS)

3364 CYCLE MEASUREMENT OF INTERNAL CONVERSION ELECTRON SPECTRA USING AN IRON MAGNETIC SPECTROMETER. Dragoun, O.; Brabec, V.; Feifrlik, V.; Kuklik, A.; Duda, F. (Nuclear Physics Inst., Rez, Czech.). Nucl. Instrum. Methods; 116: No. 3, 459-464(1974).

An iron double-focusing magnetic spectrometer was connected to a HP 2116 B computer which enabled fully automatic recording of conversion electron spectra. The cycle method of measurement with an exposure time of 0.1 to 2 s per point in one cycle was tested for electron energies from 35 to 660 keV. The regions of spectrum covered by one cycle involved 6 to 30% change in the focusing field intensity. The numerical procedure was suggested to search for possible long-time instabilities of the equipment. Large scale display with a light-pen was constructed to follow the measurements continuously and to determine several parameters of scanned conversion lines. (auth)

3365 SIMPLE COOLED Si(Li) ELECTRON SPECTROMETER. Ahmad, I.; Wagner, F. (Argonne National Lab., IL). Nucl. Instrum. Methods; 116: No. 3, 465-469(1974).

The construction of an electron spectrometer using a 80 mm^2 × 3 mm cooled Si(Li) detector has been described. The system resolutions (fwhm) for 115, 194 and 624 keV electrons were found to be 0.88, 1.06 and 1.50 keV, respectively. The resolution (fwhm) for 5.8 MeV α-particles was found to be 12.0 keV. The Si(Li) detector did not show any deterioration in performance after several warming and cooling cycles over a period of two years. The thickness of the Si dead layer on the detector face was estimated from the energy loss of low-energy electrons and was found to be 0.6 μm. The spectrometer described here can be used for the measurement of electron lines above 20 keV energy. Also because of its simple design the spectrometer can be used for $\alpha-e^-$ and $\gamma-e^-$ coincidence experiments. (auth)

3366 PROGRAM FOR LEAST SQUARES FITTING OF MOESSBAUER SPECTRA IN APPLIED MAGNETIC FIELDS. Lang, G.; Dale, B. W. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 116: No. 3, 567-571 (1974).

A program has been written to compute Moessbauer spectra of a variety of types of paramagnetic and diamagnetic materials in applied magnetic field. Both powdered and single crystal absorbers are treated; only $I = \frac{1}{2}$ to $I = \frac{3}{2}$ nuclear transitions are considered. The program compares the calculated spectrum with experimental data and varies selected parameters to minimize the mean square error. (auth)

3367 METHOD FOR THE ZERO-CHANNEL DETERMINATION IN NEUTRON TIME-OF-FLIGHT SPECTROMETRY. Abid, M.; Salama, M.; Abdel-Kawi, A.; Hamouda, I. (Atomic Energy Establishment, Cairo). Nucl. Instrum. Methods; 116: No. 3, 509-513(1974).

A method based on recording the γ-ray pulse, emitted from the reactor channel and transmitted through the rotor slits of a mechanical chopper, has been used to determine the zero channel of a neutron time-of-flight spectrometer. The experimental shape of the γ-ray pulse, recorded by the time analyzer, was fitted with a calculated expression based on the transmission of the γ-ray pulse through the chopper rotor. The accuracy in the zero-channel determination was found to be within 10 μs, which is half the channel width of the time analyzer used. (auth)

3368 SPECTROMETER FOR MEASURING CHARGED PARTICLES AND NEUTRONS. Rindi, A. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 116: No. 3, 471-475(1974).

An instrument for measuring neutron spectra in the approximate energy range of 30 to 300 MeV and proton spectra from 30 to >300 MeV has been built in our laboratory. The sensitive part of the spectrometer consists of a stack of 12 multiwire spark chambers, 13 sheets of hydrogenous material, and 15 plastic scintillators. The instrument is intended for performing measurements in weak radiation fields, such as those encountered behind the shielding of high energy accelerators. (auth)

3369 CALCULATION OF THE STABILIZATION SYSTEMS OF SPECTROMETRIC PATHS. Sheremet'ev, A. K. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1334-1336(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 38-40(1973).

A system of equations is derived which couple the characteristics of the stabilization system to the parameters of the sections which enter into its composition. An example is given of the calculation of a spectrometer-scale stabilizer. (auth)

3370 SYSTEM FOR PERFORMING MEASUREMENTS OF MOESSBAUER SPECTRA AT TEMPERATURES OF 300 TO 800°K. Chistyakov, V. A.; Ivoilov, N. G. (Kazan State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1344-1346(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 46-47(1973).

A system is described for measurement of Moessbauer spectra in the temperature range from room temperature to 800°K in the field of an electromagnet having an air gap of up to 30 mm. A photocell having an inverse characteristic is used in the temperature stabilization circuit in order to record the deflections of the mirror galvanometer. (auth)

3371 TIME-OF-FLIGHT SPECTROMETER WITH A COLD-NEUTRON SOURCE. Zemlyanov, M. G.; Golovin, A. E.; Mironov, S. P.; Syrykh, G. F.; Chernoplekov, N. A.; Shitikov, Yu. L. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1329-1333(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 34-38(1973).

A time-of-flight spectrometer is described which uses a condensed substance to study the inelastic scattering of cold neutrons. The spectrometer is mounted on the IRT pulsed reactor at the I. V. Kurchatov Atomic Energy Institute. It is equipped with a cryogenic propane source of cold neutrons with a moderator temperature ~100°K. The collimation and monochromatization system of the spectrometer ensure the isolation of the primary line of cold neutrons having $E_0 = 4.9$ MeV and $\Delta E_0/E_0 \approx 10\%$. The average flux of monochromatic neutrons on the sample for a reactor power of 5 MW amounts to 5×10^6 n/sec. The energy resolution of the spectrometer in the range of energies corresponding to the elastic scattering of neutrons is equal to ~2%. The installation may be used to measure the spectra of inelastically scattered neutrons at six angles in the interval from 15 to 90° simultaneously. A comparison is made between the described spectrometer and other installations of this type. (auth)

3372 GAS FISSION-FRAGMENT SCINTILLATION DETECTORS. Kroshkin, N. I.; Kormushkina, G. A.; Starostov, B. I.; Shipilov, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1378-1380(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 72-74(1973).

Gas (helium and xenon) scintillation detectors are described which are used in measurements of the spectra of instantaneous fission neutrons by the time-of-flight method in the nanosecond range. The detector with the helium filler was used in measurements of layers having an activity of $\sim 10^8$ α particles per second for a spectrometer time resolution of ~3.5 nsec. The energy resolution of the fission fragments for the xenon detector turned out to be 1.3 times lower than the resolution obtained by means of semiconductor detectors; the time resolution determined according to γ quanta from the fission of ^{252}Cf amounts to 2 nsec. (auth)

3373 SOURCE OF REFERENCE LIGHT PULSES BASED ON A TKh-4B THYRATRON. Bragin, A. A.; Bukhalo, O. P. (Physicomechanical Inst., Lvov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1441-1445(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 125-128(1973).

A source of light pulses which develop as a result of the discharge of a capacitor through the gas gap of a TKh-4B thyratron is described for stabilizing the energy scale of scintillation spectrometers. The results of experimental investigations of the circuit are presented, and the necessity of matching the characteristics of the radiation from the thyratron and the spectral sensitivity of the photomultiplier photocathode is demonstrated. The use of thermal compensation of the luminescence yield of the crystal allowed the temperature instability of the energy scale of the spectrometer to be reduced to 0.06%/°C. (auth)

High Energy Physics Instrumentation

Refer also to abstract 4108.

3374 (CONF-720724-P2, pp 190-193) POSSIBILITY TO USE BLACK PRONGS FOR THE LOCATION OF THE STAR CENTER IN NUCLEAR EMULSION. Cohen, J. I. (Inst. for Atomic Physics, Bucharest). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The advantages in using black prongs to locate star centers are explained. In a preliminary experiment nine stars produced in Ilford k-5 emulsion by 24-GeV protons were microphotographed on GEVAERT-23 plates. A figure of merit is derived for the method discussed. The results indicate that use of black prongs to locate interactions in emulsion is worthwhile. (2 figures) (RWR)

3375 (COO-1428-376) PROGRAMMED CONTROLLER FOR A CRT FILM SCANNER. McIlwain, R. L. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). [nd]. 13p. (CONF-740431-1). Dep. NTIS $4.00.

From conference on computer scanning; Oxford, UK (2 Apr 1974).

A programmed controller for the Purdue POLLY system for scanning bubble chamber film is described. The design strategy and parameters and construction and costs are discussed. (WHK)

3376 (COO-1428-377) 1974 STATUS OF THE PURDUE POLLY. McIlwain, R. L.; Palfrey, T. R. Jr.; Rangan, L. K.; Ammann, A. C.; Buten, R. E.; Baggett, M. J.; Olive, D. F.; Shrimplin, M. W. (Purdue Univ., Lafayette, Ind. (USA)). 1974. 9p. (CONF-740431-2). Dep. NTIS $4.00.

From conference on computer scanning; Oxford, UK (2 Apr 1974).

The parameters of the Purdue POLLY system for measuring bubble chamber film are described, and some of the initial test performance results are given. The physical layout of the precision CRT, the scanning optics, projection optics, and the film platen is illustrated. (WHK)

3377 (FRNC-TH-453) APPLICATION OF SERVOMECHANISM THEORY TO CONTROLLING THE PRESSURE IN THE GARGAMELLE BUBBLE CHAMBER. Leaux, P. (Paris-11 Univ., 91-Orsay (France)). 1972. 136p. (In French). Dep. NTIS (US Sales Only) $10.00.

Thesis.

The Gargamelle bubble chamber operated for the first time at CERN during the night of the 8th/9th December 1970. Cosmic-ray tracks were materialized and photographed as soon as the first expansion had been effected. During preliminary tests minor difficulties became apparent and questions were posed on the stability of the valves. Fears were expressed on the difficulty of controlling this relatively complex system. Such considerations led to the study of the servomechanism problems associated with the process. On the whole, the performance published in the specifications was attained, particularly concerning the transient behavior of the system following the startup of the chamber. This latter process was effected without having to make complicated and delicate adjustments to the system, this being possible as a result of the geometry of the nitrogen system which ensures a good decoupling between the different pressures. This decoupling can be effected by minimizing the effect of the valve on the pressure difference by ensuring a better symmetry between the two high pressure reservoirs. Static tests carried out on the valve demonstrated that it presented a region where it was very widely open between the maximum position of the pressure cycle and the static position. This characteristic of the system is due to the very large pressure differences occurring. It is possible to position a diaphragm in front of the valve in order to introduce a supplementary pressure drop. Such a device would also reduce the disturbance caused to the system by the large pressure difference. This pressure difference is the only difficult adjustment required because the cutting-off frequencies of the reservoirs and the valve are practically the same. The simplest way to overcome this difficulty would be to use a valve control system whose resonance frequency is considerably higher than that ordinarily used in order to work in a region above the pass band of the unit. (FR)

3378 (ISS-P-73-8) STUDY OF TOTAL ABSORPTION COUNTERS FOR VERY HIGH ENERGY PARTICLES. Baroncelli, A. (Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 15 Sep 1973. 31p. Dep. NTIS (US Sales Only) $4.75.

The development of the nuclear-electromagnetic cascade initiated by a strongly interacting particle was studied by means of the Monte Carlo method. The model used to simulate the cascade and the performances of a total absorption counter of the sample type, consisting of a sandwich of absorbers and scintillator plates, are discussed. The resolution was studied as a function of the geometry and of the incident particle energy in the range 5 to 300 GeV. The results of the calculation show that at 300 GeV an energy resolution of about ±4% can be achieved. (auth)

3379 (JINR-P13-7154, pp 37-47) DEVELOPMENT OF PROPORTIONAL CHAMBERS IN HIGH ENERGY LABORATORIES. Zanevskii, Yu. V.; Kuryatnikov, B. K.; Novikov, E. A.; Peshek-

honov, V. D.; Pugachevich, V. P. Ural'skii, D. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

In high-energy laboratories, proportional chambers with working areas up to 600 × 300 mm^2 have been developed and used. The development and operating characteristics of four proportional chambers used at the Joint Inst. for Nuclear Research are briefly described. The winding machine used in their construction is briefly described, and the gas mixture used is discussed. (JSR)

3380 (JINR-P13-7154, pp 48-57) DEVELOPMENT OF LARGE MULTIWIRE PROPORTIONAL CHAMBERS. Groshev, V. R.; Kolachev, G. M.; Minakov, G. D.; Onuchin, A. P.; Tel'nov, V. I.; Tikhonov, Yu. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The criteria used for the selection of the wire in multiwire proportional chambers are outlined. The characteristics of a position-sensitive and a shower proportional chamber are described. The characteristics of a muon chamber are also given. (JSR)

3381 (JINR-P13-7154, pp 58-69) CONSTRUCTION AND OPERATIONAL CHARACTERISTICS OF A PROPORTIONAL CHAMBER WITH DIMENSIONS 600 × 300 mm^2. Birulev, V. K.; Grigalashvili, T. S.; Gus'kov, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The construction details of the chamber and the preliminary calibrations are briefly outlined. The triggering circuit and the recording electronics are described, and the characteristics of the chamber in operation at the accelerator are discussed. (JSR)

3382 (JINR-P13-7154, pp 85-94) EFFECT OF THE COMPOSITION OF THE Ar–CO_2 GASEOUS MIXTURE ON THE CHARACTERISTICS OF A WIRE PROPORTIONAL CHAMBER. Glebov, V. Yu.; Zelenskii, A. N. (Inst. of High Energy Physics, Serpukhov, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The dependence of the efficiency and time resolution of multiwire proportional chambers on the relative concentrations of the gases in the Ar–CO_2 mixture was studied. The results showed that a change in the relative concentration alters the range of the operational voltage potential but does not affect the efficiency of the chamber. The time resolution of the proportional chamber depends substantially on the percent concentration of CO_2 in the mixture. The best time resolution was obtained for CO_2 concentrations of about 30%. (tr-auth)

3383 (JINR-P13-7154, pp 113-120) DEVELOPMENT OF THE ELECTRONICS FOR PROPORTIONAL CHAMBERS IN FOREIGN LABORATORIES. (Review). Turala, M. (Inst. of Nuclear Physics, Krakow). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

A brief bibliographic review is given of the principal lines of development of electronics for multiwire proportional chambers. Special integral circuits, electronics for individual components, and electronics for drift chambers are considered. (JSR)

3384 (JINR-P13-7154, pp 121-128) ELECTRONICS FOR THE PICK-UP AND REGISTRATION OF SIGNALS FROM A PROPORTIONAL CHAMBER. Silaev, E. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

Block diagrams of the electronics for the registration of signals are given and the time sequence of their operation is outlined. Circuits are given for amplifier-shapers. The efficiency of the registration was determined for some circuits as a function of the voltage applied to the multiwire proportional chamber. (JSR)

3385 (JINR-P13-7154, pp 129-136) DELAY AND LOGIC CIRCUIT OF A MULTIWIRE PROPORTIONAL CHAMBER. Baru, S. E.; Korshunov, Yu. V.; Savinov, G. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The part of the electronic circuit consisting of an active delay element (flip-flop) and a registration circuit (D trigger or RS trigger with coincidence circuit at the input) was examined. The value of these elements and the deficiencies of some variants are discussed. The selection of a variant in each specific case depended on the conditions of the problem to be solved. The model used was a TTL integrated microcircuit. (tr-auth)

3386 (JINR-P13-7154, pp 137-145) ELECTRONIC CIRCUIT FOR PROPORTIONAL CHAMBERS BASED ON THE TTL INTEGRATED CIRCUIT. Vishnyakov, V. V.; Lytkin, L. K.; Chernenko, L. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The possibility of designing electronic circuits for proportional chambers based on the use of an inverter logic circuit used in an amplification regime that is close to linear was examined. Possible circuits and their characteristics are discussed. (JSR)

3387 (JINR-P13-7154, pp 146-149) CAMAC SYSTEM FOR DATA READOUT FROM A SMALL MULTIWIRE PROPORTIONAL CHAMBER. Kudla, M.; Pekazh, G.; Rushovski, Ch.; Shvaglis, S. (Univ., Warsaw). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

An electronic circuit for experiments on hypernuclei spectroscopy is given in a general form. A functional circuit is given for the data readout from a proportional chamber. The operation of each is briefly outlined. (JSR)

3388 (JINR-P13-7154, pp 172-173) UNIVERSAL ELECTRONIC BLOCK FOR PROPORTIONAL CHAMBERS. Aref'ev, V. A.; Basiladze, S. G.; Guzik, Z.; Parfenov, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

An electronic unit for the registration and processing of data from a multiwire proportional chamber is briefly described. The unit is constructed of integrated circuits. (JSR)

3389 (LNF-74-4(R)) EXPERIMENT ON NEUTRINO–LEPTON SCATTERING. Barbarino, G.; Barbiellini, G.; Barbini, B. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 29 Jan 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

In the neutrino counter experiments proposed for the SPS the direction of the produced electrons cannot be measured with good angular resolution, because the subdivision of the sensitive and target materials is too coarse. A spectrometer is proposed for high energy electrons having a good angular resolution (~2 mrad) and which would allow the measurements of the electron energy with a typical resolution $\Delta E/E = 0.15/\sqrt{E_{GeV}}$. The proposed spectrometer is made up of a liquid scintillation counter and four wide gap spark chambers with lead slabs between. (WHK)

3390 (RL-73-141) ARGONNE 12 FT BUBBLE CHAMBER TRACK SENSITIVE TARGET TESTS. Ayres, J. F.; Fitzharris, E. W. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 9p. Dep. NTIS (US Sales Only) $4.00.

The testing of a CERN all-plexiglas track sensitive target, using hydrogen inside the chamber and target, was carried out in the Argonne 12 foot bubble chamber. The main objects of the test were: (1) to test the operation of the target mounting system; and (2) to examine the operation of the chamber and target at neon-hydrogen mixture operating conditions. Details are presented of the target system and of the tests carried out. (UK)

3391 (RL-74-45) SPINE: A MULTIPROCESSING DATA ACQUISITION SYSTEM FOR A HIGH ENERGY PHYSICS EXPERIMENT. Hand, R. P.; Maden, D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Mar 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

An operating system "SPINE" has been written to run on a 16K Honeywell DDP-516 computer for the π9 experiment at the Rutherford Laboratory. It is a multiprogramming system having the capability of running up to 7 user programs on a time-sharing basis. The nature of SPINE is outlined, and also the nature of a data taking program "PIMP" which has been written to operate under SPINE. By utilizing multi-buffer input/output facilities available under SPINE, an effective data rate of over 16K bytes/sec has been achieved. (auth)

3392 CALIBRATION OF A SAMPLING TOTAL-ABSORPTION DETECTOR AT 200 GeV. Barish, B. C. (California Inst. of Tech., Pasadena); Bartlett, J. F.; Buchholz, D.; Humphrey, T.; Merritt, F. S.; Nagashima, Y.; Sciulli, F. J.; Shields, D.; Suter, H.; Krafczyk, G.; Maschke, A. Nucl. Instrum. Methods; 116: No. 3, 413-415(1974).

A sampling total-absorption detector which consists of 14 stations, each made of a 4" thick plate of steel followed by a ¼" thick plastic scintillator was calibrated at NAL in a 200 GeV beam. An energy resolution of 8.6% was achieved, to be compared with a resolution of 21% at 28.5 GeV. (auth)

3393 TRACK RECOGNITION CODE FOR A MAGNETIC MULTIPARTICLE SPECTROMETER. Gilbert, D. R. (Virginia Polytechnic Inst., Blacksburg); Schreiner, W. N.; Trower, W. P.; Schuebelin, P. Nucl. Instrum. Methods; 116: No. 3, 501-507(1974).

The computer code, PITRACK, which associates sparks into tracks from digitizings produced by a system of nine cylindrical wire spark chambers operating in a 10 kG magnetic field is described. An interactive graphics code, VUE, used to develop and evaluate the recognition algorithm is also described. These codes were developed for use with the Vertex Spectrometer of the Multiparticle Argo Spectrometer System. (auth)

3394 MIR: SCANNING AND MEASUREMENT TABLES FOR LARGE BUBBLE CHAMBERS. Baton, J. P.; Blumenfeld, H.; Kochowski, C.; Miche, R.; Pichard, B.; Quidort, J.; Sauget, B.; Sellier, J. C. (CEN, Saclay, France). Nucl. Instrum. Methods; 116: No. 3, 535-540(1974).

The MIR tables described are scanning and measuring tables built for the projection of film from the big European bubble chambers, Mirabelle and BEBC. The tables stress ease of handling, good optical quality and high precision. (auth)

3395 LARGE ALUMINIUM WIRE SPARK CHAMPERS WITH MAGNETOSTRICTIVE READ-OUT. Bradamante, F.; Conetti, S.; Daum, C.; Dechelette, P.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Penzo, A.; Piemontese, L.; Renevey, M.; Schiavon, P.; Vascotto, A. (CERN, Trieste, Italy). Nucl. Instrum. Methods; 116: No. 3, 541-549(1974).

A set of 1 cm gap wire spark chambers with a sensitive surface of 300×100 cm^2 was constructed for an experiment at the CERN proton synchrotron. The Coulomb scattering was limited by using aluminium wires and by adopting a crossed-wire configuration, which allowed us to minimize the number of chambers for a given number of pairs of coordinates. The wire planes were pulsed by feeding the high voltage from strip-lines along the whole boundary of the chambers. (auth)

3396 INVESTIGATION OF A WIDE-GAP SPARK CHAMBER WITH GRID ELECTRODES. Mikhailov, V. A.; Matsaberidze, V. G.; Lomtadze, T. A.; Struchalina, A. V. (Inst. of Physics, Tbilisi, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1347-1349(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 48-49(1973).

A wide-gap spark chamber with two compartments was tested. The electrodes were fabricated from a brass grid, the pulse generator was coaxial with improved time characteristics. The distribution of the angles between the spark tracks in the compartment and the scatter of the spark centers around the approximating straight line were investigated. (auth)

3397 CHARACTERISTICS OF WIRE SPARK CHAMBERS WITH TAKEOFF OF INFORMATION ONTO FERRITE RINGS. Karpekov, Yu. D.; Konstantinov, V. F.; Makarov, G. P.; Prokhorov, A. N.; Sergeev, V. A.; Simonov, Yu. N.; Sugonyaev, V. P. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1350-1352(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 50-52(1973).

The characteristics of unitized wire spark chambers with takeoff of information onto ferrite rings and with ohmic decoupling of the wires of the high-voltage electrode are presented. The dependence of the counting characteristics and space resolution on the magnitude of the decoupling resistors is investigated. The efficiency with which 10 simultaneous particles are recorded exceeds 95%. (auth)

3398 BLOCK OF DISTRIBUTED RESISTORS FOR WIRE SPARK CHAMBERS. Vlasov, L. G.; Grigor'eva, E. V.; Konstantinov, V. F.; Pavlov, V. T.; Prokhorov, A. N.; Simonov, Yu. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1353-1354(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 53-54(1973).

The construction and fabrication technology of blocks of distributed resistors designed for wire spark chambers are described. (auth)

3399 PROCEDURE FOR FILMLESS TAKEOFF OF INFORMATION FROM WIRE SPARK CHAMBERS IN A POWERFUL MAGNETIC FIELD. Vladimirskii, V. V.; Korol'kov, I. Ya.; Novikova, N. V.; Nozdrachev, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1355-1356(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 55-56(1973).

Results are presented of studying the electrodynamic method of information takeoff from wire spark chambers in a powerful magnetic field. Models and a mockup of the chamber were used to investigate the excitation of ultrasonic waves by ponderomotive forces created by induced surface currents in a sound-guide. The characteristics of the obtained signals are close to the characteristics of signals in magnetostrictive chambers. The electrodynamic method provides the possibility of placing large wire spark chambers into the magnetic field of a spectrometer. (auth)

3400 CIRCUIT FOR THE IDENTIFICATION OF CHARGED PARTICLES. Kleimenov, V. F.; Mazitov, B. S.; Radyuk, G. A.; Yakushev, V. P. (Inst. of Nuclear Physics, Ulugbek, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1341-1343 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 44-45(1973).

A semiconductor circuit for the identification of charged particles is described which is based on the use of the well-known experimental dependence of the mean free path of a particle in the material of a counter on particle energy. The range of input pulses is 0 to 10 V, and the dead time of the instrument is 10 μsec. The circuit was used to isolate signals from protons, deuterons, and tritons having energies of up to 20 MeV. (auth)

3401 USE OF A HODOSCOPE FOR MOMENTUM ANALYSIS OF PARTICLES IN MAGNETOOPTICAL CHANNELS. Bugorskii, A. P.; Derevshchikov, A. A.; Matulenko, Yu. A.; Meshchanin, A. P.; Nurushev, S. B.; Seleznev, V. S.; Siksin, V. V.; Smirnov, E. V.; Solov'ev, L. F.; Solov'yanov, V. L.; Khodyrev, Yu. S. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1337-1340(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 40-43(1973).

The results of computations and experimental measurements of the limitingly possible momentum resolution in a magnetooptical channel for momenta of 40 to 60 GeV/c are presented. A magnetic spectrometer was likewise used to measure the momentum dispersion of the particles at the location of the hodoscope momentum analysis (h.m.a.) unit. A method is described for matching the beam image with the h.m.a., experimental results are presented, and the accuracy with which they agree with the calculations is estimated. (auth)

3402 STREAMER CHAMBER OF THE "RESONANCE" INSTALLATION AND THE SERVICING OF ITS SYSTEM. Vishnevskii, V. F.; Askarkhodzhaev, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1357-1359(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 57-58(1973).

The range of applicability and certain characteristics of the "resonance" installation are indicated. The principal singularities of the streamer chamber which is the foundation of this installation and of the photographic system and gas purification system are described. (auth)

3403 GENERATOR FOR STARTING ACOUSTIC CHAMBERS. Afanas'ev, V. N.; Kryzhanovskii, O. N.; Lebedev, P. I.; Orel'chikov, V. I.; Tomashchuk, Yu. F. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1427-1429(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 111-114(1973).

A generator is described for starting acoustic chambers using a TGI1-1000/25 thyratron as the commutating element. This overall delay of the circuit is ≈140 nsec; the maximum operating frequency, which is determined by the high-voltage rectifiers, is ≈50 Hz. (auth)

3404 ORSAY MAGNETIC DETECTOR. Quenzer, A. (Ecole Normale Superieure, Orsay, France). pp 125-133 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From 8th Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

A magnetic detector is presented. It is intended to be used, at first, in conjunction with the Orsay e^+e^- Collision Ring, and then, at a later date, after some as yet undecided modifications, in conjunction with the future Orsay DCI ring. Its originality resides in its employment of cylindrical proportional chambers having very small radiation lengths (10^{-3}). These chambers utilize both anode and cathode detection which permits a simultaneous axial and azimuthal localization to be obtained without ambiguity. The performance envisaged is discussed together with the physics program in which it will be used in the 0.4 to 1 GeV (center of mass system) energy range with the Orsay Storage Ring. (FR)

Radiometric Instruments

3405 NONDESTRUCTIVE MEASUREMENT OF COATING THICKNESS. Adhaesion; 16: No. 11, 389-391(1972). (In German).

A comparison of different methods, i.e., magnetic method, eddy current testing, beta backscattering method, and capacitive method, is presented. (GE)

3406 STUDIES ON THE MEASUREMENT OF SOIL MOISTURE CONTENT AND DENSITY USING THE NUCLEAR GAGES. Saito, N.; Kimura, K. (Obayashi-Gkumi, Ltd., Tokyo). Obayashi-Gumi Gijutsu Kenkyusho-Ho; No. 6, 133-137(Aug 1972). (In Japanese).

Though methods of measuring moisture content and density of soil with neutron moisture gages and γ-ray density gages are widely and commonly applied, technical problems of the measurement to be solved still remain. There is not lack of uniformity of thickness in one guide tube, but differences in the thickness exist among guide tubes, which generally cause measuring errors. Output change due to the eccentricity of a probe in a guide tube causes small influences on the density gages, but requires use of the guide tubes with a max. gas limitation of 5.73 mm in the moisture gage. It has been revealed that the count-rate of the neutron moisture gages in sea water of standard salinity decreases by 5.8% compared with that in pure water. The surface type neutron moisture gages and γ-ray density gages are not affected by the output variation based on soil quality and ground compactness, compared with conventional methods. (JA)

3407 AUTOMATIC CONTINUOUS DENSITY DETERMINATION USING GAMMA RADIOMETRY. Brown, D. J.; Nolan, P. F.; Rothwell, E. (Univ. of Sheffield, Eng.). Non-Destruct. Test. (Guildford, Engl.); 7: No. 2, 76-81(Apr 1974).

A technique based on the attenuation of γ-rays has been developed successfully for the automatic continuous measurement of density changes. It was originally designed as a new instrument for use in thermal analysis but other applications are envisaged. Chemical changes, if occurring, can be ignored by choosing certain γ-ray emitting radioisotopes. An example of the use of the technique is described in which the thermal decomposition of a solid hydrocarbon is studied. The advantages of the technique are described. (auth)

3408 AGC FOR RADIATION COUNTER. Fishman, J. B.; Mutschler, W. E. (to Nucleonics Development Co.). US Patent 3,800,143. 26 Mar 1974. Filed date 16 Feb 1972. 8p.

An apparatus for detecting nuclear radiation from a source not absorbed by the target material in order to measure density or thickness of the material is described. The apparatus employs a process for detecting radiation particles which converts the energy level of the particles to pulse height, through a photomultiplier tube, one pulse for each separate particle detected, and develops an automatic gain control signal for stabilizing the gain of the conversion system through the high voltage power supply of the photomultiplier tube by effectively comparing the pulse rate of a low level threshold detector used to reject noise pulses in the conversion system with some multiple R of a higher level threshold detector where R is the anticipated ratio of low energy level particles to high energy level particles predetermined from an energy level spectrum or histogram of the source. The multiple R is introduced by dividing the lower-level rate by the product RN while the upper level rate is divided by N, where N is an arbitrary integer. (Official Gazette)

3409 ECONOMICAL SEMICONDUCTOR MEASUREMENT CIRCUIT FOR A SCINTILLATION DEFECTOSCOPE. Kapranov, B. I. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1408-1410(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 97-98(1973).

A transistorized measurement circuit has been developed which can be used in radiation defectoscopes and thickness meters which operate in an average-current mode. The circuit allows the resistance of the anode load of the photoelectron multiplier to be increased to 10 to 50 GΩ. The input stage is implemented using a KP103 field-effect transistor. The drift of the circuit does not exceed 50 mV when the temperature varies in the 0 to +50°C range. A pointer meter or an automatic pen recorder may be used as the indicator. The current drawn does not exceed 1.5 mA. The long-term drift at a temperature 20 ± 5°C does not exceed ±5 mV per day. (auth)

3410 VALVE FOR RADIATION DETECTION OF LOW PRESSURE IN PNEUMATIC TIRES. Johnsen, E. C. US Patent 3,801,787. 2 Apr 1974. Filed date 21 Jan 1970. 8p.

A pressurized attachment for the valve of a pneumatic tire containing a small amount of radioactive material is described. The attachment has a pressure chamber on one end thereof, the other end communicating directly with the pneumatic tire. If the pressure in the tire falls below a predetermined limit, the radioactive material escapes from its shielded housing and flows into the tire. Radioactive emissions then pass through the housing of the tire and are detected by a sensing device. The sensing device is coupled to the instrument panel of the associated vehicle and serves to indicate a leak in the tire. (Official Gazette)

3411 EPITHERMAL NEUTRON LOGGING. Sherman, H.; Tittman, J. (to Schlumberger Canada Ltd.). Canadian Patent 925,227. 24 Apr 1973.

An apparatus for borehole logging in connection with petroleum prospecting consists of a sonde fitted with an isotopic neutron generator, a detector for epithermal neutrons, and associated electronic circuitry. The converted output from the detector is a measure of the porosity of the geological formation penetrated by the well. A special scraper on the side of the sonde is pressed by folding legs against the side of the well so that adhering mud is scraped away, and the detector impinges on the actual wall of the borehole. (CA)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 3323.

3412 (N-74-12433) PROTON-RADIATION DAMAGE IN GUNN OSCILLATORS. Johnson, J. W.; Fales, C. L. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Dec 1973. 28p. (NASA-TN-D-7348; L-9042). NTIS $3.00.

The irradiation effects of 22-MeV protons on the electrical characteristics of GaAs continuous-wave Gunn oscillators was studied. The radio frequency power output was reduced by 3 decibels at proton fluences in the neighborhood of 1.5×10^{12} protons/sq cm. Conductance measurements indicate that the carrier removal rate at high electric fields remained roughly 40% less than at low fields. Diode efficiencies of two device groups were found to be monotonically decreasing functions of fluence. Frequency modulation noise was generally unaffected by radiation, but the magnitude of the noise in the noise power spectrum increased significantly. These effects are partially accounted for, in a qualitative fashion, by a model of electron traps having field-dependent net-carrier capture rates and various response times. (auth) (STAR)

3413 A COMPUTER CONTROLLED SYSTEM FOR TIMING THE CRAB PULSAR. Groth, E.J.; Nelson, M.R. (Joseph Henry Laboratories, Physics Department, Princeton University, Princeton, N. J. 08540). Rev. Sci. Instrum. 45: No. 3, 440-442 (Mar 1974).

A computer system which controls optical timing observations of the Crab pulsar is described. (auth)

3414 REACTOR EQUIVALENCE OF AN ARBITRARY NEUTRON SPECTRUM BY MULTISOURCE SYNTHESIS. McKenzie, J. M. (Sandia Labs., Albuquerque, NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 18-24(Aug. 1973).

An arbitrary neutron spectrum is changed to a multiplicity of simulation spectra and thereby converted to a reactor equivalent neutron fluence. The method is experimental giving both the magnitude and error of the equivalence. It is applicable to circuits and systems as well as to devices. (auth)

Miscellaneous Instruments

Refer also to abstracts 2531, 2539–2541, 2564, 3083, 3464, and 5038.

3415 (ORO-2401-83) DISPLAY SYSTEMS. Erickson, J. J. (Vanderbilt Univ., Nashville, Tenn. (USA). Div. of Nuclear Medicine). 1972. Contract AT(40-1)-2401. 12p. Dep. NTIS $4.00.

Some of the factors which influence the quality of photographs in nuclear medicine imaging are discussed. Also, the photography of cathode-ray tube displays, e.g., Anger cameras, is discussed. (WHK)

3416 (SGAE-2242) MATERIAL ANALYSIS WITH A NEW HIGH CURRENT SECONDARY ION MASS SPECTROMETER. Pichlmayer, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Inst.). Feb 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

A secondary ion mass spectrometer for material and concentration profile analysis has been developed and built. It consists of a duoplasmatron ion source with primary beam formation system, target changer, secondary ion energy selector, and quadrupole mass filter. Mass resolution, dynamic range and transmission, of the secondary ion analyzer were investigated comparing thermal and sputter ion detection. Material analysis of several standards and samples and concentration profile measurements of implanted Cs into SiC are made by means of this apparatus. (auth)

3417 PULSE AMPLIFIER WITH DISCRETE AUTOMATIC GAIN CONTROL. Dvornikov, V. D.; Komarov, V. M.; Yudin, L. I. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1467-1469(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 145-147(1973).

A positive-pulse amplifier with automatic gain control from 4 to $\sim 2 \cdot 10^3$ is described. The variation step of the gain is a multiple of ~2. The rise time does not exceed 8 nsec throughout the entire range of gain variation. The maximum output voltage is ~6V. The amplifier is designed for operation of systems with pulse-width and pulse-code modulation. (auth)

3418 OPTICAL MECHANICAL DEVICE FOR THE DEFLECTION OF A LIGHT BEAM. Kol'tsov, I. M.; Mamaev, V. L.; Mikheev, V. P.; Rozov, B. S. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1550-1551(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 213-214(1973).

An opticomechanical device is described for the deflection of a light beam with simultaneous measurement of the deflection angle for automatic handling of experimental information represented in photographic form (photographs from bubble and spark chambers, holograms, photoemulsions, etc.). The deflection range is ±6° with respect to each of the axes for a reading quantization step 0.2''. The requirements governing the fabrication accuracy of individual elements and the results of tests performed on a laboratory mockup are indicated. (auth)

3419 IS THE $^{12}C(d,d_0)$ REACTION A GOOD POLARIZATION STANDARD? Arvieux, J. (Univ. of California, Berkeley); Birchall, J.; Conzett, H. E.; Dahme, W.; Haeberli, W.; Larimer, R. M. Nucl. Instrum. Methods; 116: No. 3, 605-607(1974).

The suitability of $\vec{d}-^{12}C$ elastic scattering as a deuteron polarization analyzer is examined. It is concluded that ^{12}C is suitable as a polarization standard at 30 MeV, but should be used with caution below 30 MeV. (auth)

3420 TUNNEL-DIODE COMPARATOR WITH CONTROLLED HYSTERESIS. Ghelfan, P. (M. G. Electronics Ltd., Rehovot, Israel). Nucl. Instrum. Methods; 116: No. 3, 611(1974).

To improve its reset accuracy a conventional transistor-pair–tunnel-diode comparator, was completed with an auxiliary comparator. (auth)

3421 POLARIZING MIRRORS FOR ATOMIC BEAMS. Brautti, G. (Istituto di Fisica, Bari, Italy). Nucl. Instrum. Methods; 116: No. 3, 609-610(1974).

A new method to produce polarized atomic beams is proposed. It provides potentially highly focused, intense beams with many other interesting optional features. (auth)

3422 COMPUTERIZED MEASURING SYSTEM FOR NEUTRON PHYSICS EXPERIMENTS. Grosshoeg, G. (Chalmers Univ. of Tech., Gothenburg, Sweden). Nucl. Instrum. Methods; 116: No. 3, 561-566(1974).

A minicomputer has been incorporated in a system for neutron physics measurements. The computer cooperates with NIM modules and an Intertechnique memory block. The computer has been equipped with a time analyzer for the pulsed neutron-source method of measurement and a special direct memory-access channel for nuclear physics analog-to-digital converters and other purposes. The measuring system uses a general method, which is based on a compromise between hardware and software programs. An interactive operating system (LATOS) for a small configuration is designed and this is supplemented with a formula-to-assembler translator (FOPAL). (auth)

3423 HIGH-EFFICIENCY POLARIMETER FOR 8 TO 16 MeV PROTONS. Clare, J. F. (Univ. of Auckland, New Zealand). Nucl. Instrum. Methods; 116: No. 3, 525-534(1974).

The efficiencies as analyzers of proton polarization of elastic scattering in helium and carbon are compared by contour diagrams of $P^2\,\sigma/\epsilon$ for 4 to 13 MeV protons. The design and performance of a helium polarimeter are described. In this instrument conical vanes collimate protons scattered in a high-pressure gas target and two thin-scintillator transmission detectors preceding the helium target are used to eliminate background counts. Expressions are given for the sensitivity of vaned polarimeters to misalignment of the incident proton beam and for the asymmetries which arise when the proton source is a thick gas target and when the proton flux is anisotropic. (auth)

3424 ACCURATE DIGITAL INSTRUMENT TO MEASURE REACTOR PERIOD. Scott, E. W.; Stigall, P. D. (Univ. of Missouri, Rolla). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 12-17(Aug 1973).

At facilities having a research-training reactor, such as the University of Missouri–Rolla Reactor (UMRR), one finds it necessary to perform a large number of rod calibrations during the course of the year. In practice rod worths are determined by measuring the reactor period created by an incremental withdrawal of the rod under calibration. Period is then related to reactivity through the use of a publication such as the AEC publication, IDO-16485. This frequent measurement of period makes it desirable to have a simple, automatic and accurate method to make such measurements. At UMRR we have designed, constructed and installed such an instrument. The instrument measures doubling time rather than period, but through the use of an internal time base conversion, displays a four bit decimal number that is the reactor period in seconds. The instrument is simple in concept and utilizes the 7400 Series integrated circuits in the largest portion of the unit. The instrument is easy to operate and once initiated, will automatically complete the measurement of the period displaying the results. Error in the instrument can be shown to be less than 1.5%. Thus the unit meets the three requirements of simplicity, accuracy and ease of operation and in addition is moderately inexpensive, less than $120. (auth)

3425 NANOSECOND PULSE AMPLIFIERS. Jackson, H. G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 3-16(Oct 1973).

Examples are given of the use of pulse amplifiers in three areas of experimental nuclear physics. The necessity of low noise at the input of these amplifiers leads to a discussion of electronic noise. The need for pulse-shaping networks in amplifiers particularly designed for accurate amplitude analysis is emphasized. The technique of using negative feedback to obtain nanosecond pulse amplifiers is discussed. Calculated and experimental results are given for two series-shunt feedback pair amplifiers. The necessity of using the hybrid fabrication technique in sub-nanosecond pulse amplifiers is shown as well as the characterization of the transistors and complete amplifier with the scattering (s) parameters. An annotated bibliography is included as an appendix. (auth)

3426 NANOSECOND TRIGGER CIRCUITS. Barna, A. (Hewlett-Packard Labs., Palo Alto. CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 17-21(Oct 1973).

A summary of switching properties of high-speed trigger circuits is presented. The introduction of general characteristics is followed by a review of switching in tunnel-diode trigger circuits, and by an analysis of a simple transistor circuit. (auth)

3427 NANOSECOND COINCIDENCE MEASUREMENTS. Kirsten, F. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 22-35(Oct 1973).

Some of the basic information regarding the design and use of circuits, i.e., coincidence circuits, for time coincidence measurements on pulses having durations of the order of nanoseconds is summarized. The design features of contemporary circuits are discussed. Some performance parameters are listed and techniques of evaluating the performance of coincidence circuits are mentioned. The sending, transmission, and receiving of fast pulses is reviewed. The special cases of majority logic and coincidence matrices are briefly discussed. (auth)

3428 REVIEW OF SUB-NANOSECOND TIME-INTERVAL MEASUREMENTS. Porat, D. I. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 36-51 (Oct 1973).

A review of time-interval measurements in the subnanosecond regime is presented and the various methods are compared as to their precision, stability, resolution, and other essential parameters. Calibration methods, stabilization, and correction for time walk are also discussed. (auth)

3429 HIGH SPEED DIGITAL-TO-ANALOG AND ANALOG-TO-DIGITAL TECHNIQUES. Henry, T. W. (Motorola, Inc., Phoenix, AZ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 52-66(Oct 1973).

Several techniques for doing high-speed digital-to-analog and analog-to-digital conversion are described. In particular, those techniques which either are being implemented monolithically or have the possibility of monolithic fabrication are discussed. Several of these systems are examined in detail and a respective comparison is given between the systems with respect to speed, accuracy, cost, etc. (auth)

3430 NEW APPROACH TO THE DESIGN OF AMPLITUDE TO CODE CONVERTERS. Hassan, M. A.; Ivanov, V. S. (Atomic Energy Establishment, Cairo). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 5, 77-82(Oct 1973).

A pulse amplitude to code converter (ACC) for use in multichannel analysis with a computer based data aquisition system is developed. A new design concept was chosen based on pulse sampling and storage. The approach has minimum differential and integral non-linearity, maximum stability and modular structure. The pulse storage is done on a switched condenser and the amplitude to code conversion carried out using the up-down integration method. Encapsulated and integrated modules, as well as field effect switches are used in the realization. The resulting ACC is simple, accurate, stable and requires a little development effort. An experimental unit with 1024 channel resolution was built and interfaced to a mini-computer. Tests showed very promising results. (auth)

3431 VERSATILE LOGIC SYSTEM FOR USE IN NUCLEAR EXPERIMENTS ON SCIENTIFIC SATELLITES. Cancro, C. A. (Goddard Space Flight Center, Greenbelt, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 32-37(Aug 1973).

An improved fast low-power-drain logic system has been developed for use in nuclear experiments on scientific satellites. The basic unit of the system is an AND-NAND gate which has a response in the 10 nanosecond range, a power drain of 2.0 milliwatts and operates over the temperature range of −40°C to + 80°C. In addition to providing the AND-NAND logic functions, one or more of the basic units may be connected to yield the following: a) monostable pulse generator, b) pulse generator yielding an output pulse at the leading edge of the input pulse, c) delay, d) threshold detector, and e) bistable circuit. The system requires relatively simple circuitry for interfacing at its outputs and inputs. (auth)

3432 IMAGE PROCESSING IN MEDICINE: A SUMMARY OF THE STATE OF THE ART. Goodell, W. V. (E-Systems, Inc., Falls Church, VA). Automedica; 1: No. 1, 19-28(Jan 1974).

The three major use areas of medical image processing are radiology, cytology, and nuclear medicine. It has become possible in these areas to analyze specific types of radiographs and real images to detect abnormalities. Cervical cancers; bone, lung, and cranial tumors; valvular heart diseases; small bowel disorders; gastric ulcers; cellular and chromosomal defects; and various other morphological and spectroradiometric evidence of disease are being detected and analyzed rapidly and efficiently with increased reliability and confidence. The degree of reliability and confidence varies with each specific image type, and effort is being expended to improve accuracy and decrease false alarm rates. Other medical uses of image processing are emerging as equipments and techniques coincide with the needs of hospital clinics and medical research laboratories. It appears that the specialized or dedicated image processor is gaining favor at an accelerated rate, especially as useful, reliable, and moderate-cost systems become available. (111 references) (auth)

3433 GENERATOR THAT PRODUCES NANOSECOND PULSES FOR SUPPLYING LIGHT-EMITTING DIODES. Baldin, B. Yu.; Tsisek, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1438-1440(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 122-124(1973).

A 10-channel generator that produces nanosecond pulses for supplying light-emitting diodes for the simulation of light flashes in scintillation and Cherenkov counters for calibration purposes is described. The amplitude of the output signals is 130 ± 10 V, the rise time is ≤4 nsec, the decay time is 15 nsec. The amplitude stability of the signal is 0.1%. The limiting operating frequency is 1 kHz. The generator was designed and tested at the LNP and the JINR. (auth)

3434 PERTURBATION OF THE MAGNETIC FIELD OF AN ACCELERATOR BY A METALLIC VACUUM CHAMBER. Zhukov, B. N.; Lebedev, V. N. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1318-1322(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 26-29(1973).

A calculation is presented of the perturbations of the magnetic field by metallic vacuum chambers having elliptical and circular cross sections in the magnets of accelerators with combined functions (in "synchrotron" magnets) and in the magnets of accelerators with separated functions (in rotatable magnets and quadrupole lenses). The calculations are carried out with allowance for the reflection of eddy currents in the poles of the magnet. Good agreement between the results of the calculation and experimental data is shown. Equations are presented for calculating the perturbations of the field by a metallic chamber in the iron-free magnets of a superconducting synchrotron. (auth)

3435 CREEP CELL, IN PARTICULAR FOR NUCLEAR REACTORS. Cartier, L. (to Commissariat a l'Energie Atomique). US Patent 3,803,365. 9 Apr 1974. Priority date 29 May 1970, France. 4p

A creep cell for studying time-dependent deformations of a test-piece as a function of applied tensile force and irradiation is described. The creep cell comprises within a leak-tight enclosure a cylindrical test-piece provided at one end with a stationarily fixed disc and at the other end with a movable disc associated with a first piston, a reference test-piece rigidly fixed to a second piston, means for applying a known and variable pressure P_e to the first piston so as to induce a stress in the test-piece, means for applying a known and variable pressure P_r to the second piston so as to permit comparative measurement of the deformations of the two test-pieces and a microwave resonant cavity for measuring the displacement of the second piston. (Official Gazette)

3436 WELL LOGGING SYSTEM AND METHOD. Arnold, D. M. (to Texaco Inc.). US Patent 3,801,816. 2 Apr 1974. Filed date 25 May 1971. 16p.

A radioactivity well logging system is provided for making both a conventional log and a novel spectral analysis of the activation-produced radiation during the same trip through the borehole. The neutron source is pulsed to provide successive irradiation and quiescent intervals, and the resulting radiation may be detected during the irradiation intervals to provide conventional measurements such as an N-gamma log. During each quiescent interval, and after the neutrons produced during the preceding irradiation interval have disappeared, a spectral measurement is made of the radiation emitted by the unstable isotopes in the earth. The signals from a multichannel analyzer may further be examined by comparison with a predetermined composite spectrum assumed to relate to a predetermined particular lithology. (Official Gazette)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 5705.

3437 (AEC-tr-7537) PROCESS FOR ISOTOPE SEPARATION. 12 Mar 1973. Translation of German Patent 2,312,194. 15p. Dep. NTIS $4.00.

A process for the separation of uranium isotopes using tunable laser light is presented. (TFD)

3438 (INIS-mf-1219) PROSPECTIVES OF THE BRAZILIAN MARKET SUPPLY OF ENRICHED URANIUM. Moraes Filho, J. E. (Minas Gerais Univ., Belo Horizonte (Brazil)). 1972. 252p. (In Portuguese). INIS.

Thesis.

A description is given of the methods used for enrichment of uranium and of the main problems present in the implementation of such technology. Subsequently, an analysis is made of the use of enriched uranium in power reactor programs. The market for uranium enrichment services is described, showing the growth in the demand for such services, main programs in progress for new plant construction, costs for plant installation, and costs per unit of separative work. Finally, the Brazilian case is taken into consideration, studying alternatives to supply the country's requirements either by the purchase of uranium enrichment services abroad, or by the installation of enrichment plants in Brazil. (INIS)

3439 (INS-J-145) SECOND PROGRESS REPORT ON INS ISOTOPE SEPARATOR. Kaneko, K.; Iwata, K.; Tanaka, J.; Fuchi, Y.; Ueda, N.; Chida, K.; Ohoshiro, Y.; Sakai, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 6 Mar 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

The INS isotope separator was constructed in 1956. After the test operation, about one hundred isotopes were separated and supplied to various institutions from 1960 to 1973. In recent years, the isotope separator was served for the use of wide research areas such as nuclear physics, solid state physics, nuclear chemistry, geophysics and geochemistry. Results until 1964 were reported in INS-J-92 as the first progress report. This report was prepared on the work of the INS isotope separator from 1965 to 1973 and on its application to ion implantation. (auth)

3440 (MLM-2144(tr)) SEPARATION OF LIQUID ISOTOPE MIXTURES BY THERMAL DIFFUSION. Rabinovitch, G. D.; Gurevich, R. Ya.; Ivaknik, V. P. (AN Belorusskoj SSR, Minsk). 3 May 1974. Translated from pp 401-415 of Teplo- i Massoperenos, Doklady Vsesoyuznogo Soveshchaniya po Teplo- i Massoperenosu, 4th, Minsk, May 1972. 18p. Dep. NTIS $4.00.

Development of low-cost methods for obtaining stable isotopes is an urgent problem on whose solution to a large extent depends whether they can be widely used in the national economy. The greatest difficulties arise in the development of methods for enrichment of stable isotopes of heavy elements. The electromagnetic method currently used for this purpose is characterized by a small efficiency and high losses of the initial substance and, in connection with this, the cost of the final product is very high. Other promising methods include centrifugal separation and thermal diffusion. The use of the first method is limited to applications for separation of such isotopes which enter into compositions of highly volatile compounds. This shortcoming is to a large extent avoided in the thermal diffusion method which makes it possible to realize the process of concentrating isotopes in the liquid phase including solutions and alloys. A number of theoretical and experimental results which are necessary for constructing an efficient thermal diffusion apparatus are presented. (auth)

3441 HYDROGEN–WATER DEUTERIUM EXCHANGE OVER GRAPHON SUPPORTED GROUP VIII NOBLE METALS. Sagert, N. H.; Pouteau, R. M. L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Phys.; 51: No. 24, 4031-4037(15 Dec 1973).

Specific activities of Group VIII noble metals supported on Graphon have been determined for hydrogen-water deuterium exchange. Metal surface areas, which are required to calculate specific activities, were measured by hydrogen chemisorption, and by reaction of hydrogen with chemisorbed oxygen. For the second triad metals, ruthenium, rhodium, and palladium, and in the temperature range 140 to 225°C, the variation of activity was Ru < Rh > Pd. For the third triad metals, osmium, iridium, and platinum, the variation of activities was Os < Ir < Pt in the same range of temperature. Apparent activation energies were measured over this temperature range, and orders of reaction with respect to hydrogen and water were measured at 160°C (200°C for Pt). From these data, activation energies for the surface exchange reaction were calculated. In the second triad the activation energies decrease slightly with increasing atomic number, but in the third triad they decrease quite markedly with increasing atomic number. A good correlation was obtained between the activation energy for surface exchange and the thermionic work function of the metal. This supports an earlier suggestion that Graphon is able to donate electrons to the metal and thus lower the activation energy for the surface exchange. (auth)

3442 EXTENSION OF THE ^{14}C DATING METHOD BY QUANTITATIVE ISOTOPE ENRICHMENT IN SEPARATION TUBES. Felber, H.; Pak, E. (Oesterreichische Akademie der Wissenschaften, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl.,; 180: No. 8-10, 299-316(1973). (In German).

The construction of a thermal diffusion isotope separation plant consisting of two columns of 2 m length with a heating power of 5 kW is described. For the unusually thick heating tubes a special heater had to be developed. The plant is in use for the enrichment of ^{14}C in methane. With an available sample of 90 g carbon, the upper age limit of the dating equipment can be raised by 25,000 y. The uncertainty of the date due to the enrichment is less than about 400 y. (auth)

3443 SEPARATIVE POWER OF GAS CENTRIFUGES FOR LARGE SCALE URANIUM ENRICHMENT. Fuhse, W. A. (Urenco Ltd., Marlow, Eng.). Atomkernenergie; 23: No. 1, 28-33(1974).

The maximum separative power of countercurrent centrifuges increases with the fourth power of the peripheral velocity according to Dirac. Experimental results previously reported show that the increase can only be described by a third power law. The effects tending to reduce the predicted separative power were studied. It was found that the radial distribution of the concentration near the end caps of the centrifuge is more important on the separative power than anticipated previously. It is indicated what separative power can be expected from simple centrifuges of the Zippe type and how the boundary conditions have to be modified to reach the separative powers predicted by Dirac. (GE)

3444 HEAVY WATER OUTPUT RISES AS DESIGNERS LOWER LIQUID LOADING ON TRAYS. Can. Chem. Process.; 57: No. 12, 43(Dec 1973).

Canada's heavy water production rates are being increased from the 60% range to well over 80% as the result of a 2½-in decrease in weir-height on the sieve-trays in the isotopic exchange columns of the 400-ton/y enrichment units. This solution to the "bump" problem, which would occur as a tower neared 60 to 70% capacity, was resolved jointly by representatives of CGE, Union Carbide, Lummus of Canada, Ontario Hydro and Atomic Energy of Canada. The experiment was made initially with Bruce enrichment unit No. 2, which has since had eight months of successful operation at the higher capacity levels. Corresponding changes have been made to Port Hawkesbury and Bruce No. 1 and now all three units are producing at 80% capacity or better. (CA)

3445 LA SEPARATION DES ISOTOPES. (Separation of Isotopes). Chemla, M.; Perie, J. Paris; Presses Universitaires de France (1974). 247p.

The various techniques used for isotope separation and the theoretical bases of each technique are discussed. The characteristics of stable isotopes and their analysis are first reviewed. The techniques described for isotope separation are electromagnetic separation, physico-chemical separation methods, separation cascades, gaseous diffusion, diffusion in a gravity field and ultracentrifugation, and thermal diffusion. The chemical equilibria of isotopic exchange are considered. The steps in the production of heavy water are outlined in conclusion. (JSR)

3446 PRODUCTION OF ENRICHED URANIUM IN EUROPE. Leduc, C.; Mezin, M. (CEA, Paris). Sci. Tech. (Paris); No. 10, 45-50(15 Jan 1974). (In French).

The European enriched uranium requirements are presented together with the existing world production capacities, the currently used enrichment processes, and the envisaged European projects. (FR)

3447 PRESENT STATE OF URANIUM ENRICHMENT IN JAPAN. Wada, M. (Kansai Electric Power Co. Inc., Osaka). At. Jap.; 17: No. 4, Suppl., 89-95(Apr 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

According to the AEC's long-range program on the development and utilization of atomic energy, nuclear power generation in Japan will reach the level of 100,000 MW(e) by 1990. The uranium enrichment to meet such a requirement is essential. In the long-range point of view, there is a limitation in the supply of enriched uranium from the U. S. To go through the short supply period, employment of the gaseous diffusion process is advisable because of its proven technology. The technological realization of the centrifugal method is yet to be realized. The current views toward enrichment problem by the AEC are that immediate operation by the gaseous diffusion process must be sought in an international joint venture. The centrifugal process is envisaged as a possible method for future enrichment in a domestic plant in Japan. (JA)

3448 FORTHCOMING DECISIONS IN THE FIELD OF URANIUM ENRICHMENT. Coates, J. H. (CEA, Paris). At. Jap.; 17: No. 4, Suppl., 65-82(Apr 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

Concerning the pressing need of more uranium enrichment accompanying the rapid advance of nuclear power generation, the following phases are reviewed: the need for additional enrichment plants; the organized studies on the establishment of a gaseous diffusion plant with French participation; and the need and system of partnership. Prediction of the need for additional enrichment facilities depends on the relation of demand and capability of enrichment plants, and the decision to move is made accordingly. For the organized studies with French participation, the short term strategy developed by CEA to make a decision in due time is explained. Among the various reasons calling for partnership is the inability of nations to sponsor a good project by themselves, because of technology and political stability. (JA)

3449 TRIPARTITE CENTRIFUGE ENRICHMENT PROJECT. Parry, J. V. L. (Urenco Ltd., Marlow, Eng.). At. Jap.; 17: No. 4, Suppl., 53-65(Apr 1973).

From sixth annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The centrifugal uranium enrichment process, which had been overshadowed by gaseous diffusion process, is now attracting worldwide interest. The advances made in this field in the Netherlands, Germany and the U. K., including the rapid development of various centrifuge types on a semi-industrial scale, together with the commercial possibility, led to the Almelo Treaty of 1970, and the establishment of joint companies, i.e., Urenco—enrichment organization and Centec—prime contractor to the Urenco for plant development, design and construction. The progress made by the joint companies and their future plans are reviewed as follows: development since 1971; position of national demonstration plants; status of centrifuge production; Urenco plant build-up program; centrifuge plant economics; and the Association for Centrifugal Enrichment. (JA)

3450 U. S. URANIUM ENRICHMENT SUPPLY POLICY. Friedman, A. S. (Atomic Energy Commission, Washington, DC). At. Jap.; 17: No. 4, Suppl., 82-89(Apr 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The area of greatest interest to Japan, which is planning a major nuclear power generation program, is the supply of uranium enrichment services. In this connection, the new policy of fixed commitment-type contracts in the U. S. is explained. Against this announcement, the argument of the policy being overly severe is prevalent the world over. The basic concept of this policy is the acceptance by customers of a considerable portion of financial risk. Salient points about the new policy are the period from signature to delivery of initial core, downpayment, the conditions of contract termination, and separative work charge. While the new policy places large responsibility on the part of customers, far greater benefit for the customers is evident, which is the resultant ability of supplier to provide uninterrupted long-term enriching service. (JA)

3451 SEPARATION FACTOR OF HYDROGEN AND DEUTERIUM BY SUSPENSION ELECTROLYSIS USING MERCURY CATHODE. Shinagawa, M.; Tsuruno, H.; Saito, H.; Mizusaki, H.; Muromatsu, A. (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 12, 719-725(Dec 1973).

The electrolytic separation factor between hydrogen and deuterium was examined using mercury or platinum cathodes immersed in 1F NH_4Cl in 10 vol % D_2O water containing cobalt sulfide powder in suspension. Several other kinds of powdered materials in suspension were also studied. In the case of mercury pool electrode, the materials added in suspension were effective in enhancing the hydrogen/deuterium separation factor, but powder suspension was ineffective on platinum plate electrodes. The powdered material added in suspension served as catalyst on the hydrogen evolution reaction at the mercury cathode. The influence of the applied potential on the separation factor was studied over the temperature range of 15° to 80°C. The results provided an indication of the rate-determining steps governing the electrolytic hydrogen evolution. The experimental values obtained for the separation factor and activation energy gave an insight into the mechanism of the rate-determining step of the hydrogen evolution at the working electrode. (auth)

3452 ENRICHING POLITICS OF SOUTH AFRICA'S URANIUM. Muller, H. New Sci.; 62: No. 896, 252-254(2 May 1974).

It is considered that it is probably the need for greater export earnings rather than any atomic weapons ambition that is the driving force behind South Africa's bid to develop its own nuclear fuel industry. Great secrecy, breeding much speculation, surrounds the enrichment process which South Africa has stated is unique. It is argued that this process is probably either an ion-exchange or liquid extraction method rather than the West German jet-nozzle process. (UK)

Isotopic Power Sources

3453 (N-74-14363) ISOTOPE HEAT SOURCE SIMULATOR FOR TESTING OF SPACE POWER SYSTEMS. Prok, G. M.; Smith, R. B. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Dec 1973. 15p. NTIS $2.75.

A reliable isotope heat source simulator was designed for use in a Brayton power system. This simulator is composed of an electrically heated tungsten wire which is wound around a boron nitride core and enclosed in a graphite jacket. Simulator testing was performed at the expected operating temperature of the Brayton power system. Endurance testing for 5012 h was followed by cycling the simulator temperature. The integrity of this simulator was maintained throughout testing Alumina beads served as a diffusion barrier to prevent interaction between the tungsten heater and boron nitride core. The simulator was designed to maintain a surface temperature of 1311 to 1366°K (1900 to 2000°F) with a power input of approximately 400 W. The design concept and the materials used in the simulator make possible many different geometries. This flexibility increases its potential use. (auth) (STAR)

3454 RADIOISOTOPE FUEL MATERIAL AND METHOD. Keshishian, V. (to Rockwell International Corp.). US Patent 3,790,440. 5 Feb 1974. Filed date 13 Jan 1971. 12p.

A primary alpha-particle-emitting radioactive fuel material and a method for preparing it so that secondary neutron generation by an alpha-neutron reaction is substantially reduced is described. Those individual isotopes of oxygen, carbon, nitrogen, silicon, and chlorine which have a threshold for the alpha-neutron reaction greater than the maximum energy of the emitted alpha particles are selected for combination with the alpha-particle-emitting radioactive isotope to give the desired oxides, carbides, nitrides, silicides, and oxychlorides. (14 claims, 1 drawing figure) (Official Gazette)

3455 PREPARATION OF $^{238}Pu^{16}O_2$. Nance, R. L.; Leary, J. A.; Mullins, L. J. (to United States Atomic Energy Commission). US Patent 3,801,700. 2 Apr 1974. Filed date 28 Mar 1972. 4p.

A method of preparing $^{238}Pu^{16}O_2$ in which massive electrorefined ^{238}Pu is powdered by successive hydride-dehydride cycles. The powdered and largely but not completely dehydrided ^{238}Pu is then reacted with gaseous $H_2{}^{16}O$ in a helium stream in a temperature of 580 to 610°C. The oxide thus produced is then heated to 700°C under vacuum for a short time to remove volatile impurities. (Official Gazette)

3456 SOME CHARACTERISTICS OF RADIOISOTOPE POWER SOURCES IN AN OCEAN ENVIRONMENT. Erdmann, R. C.; Gritton, E. C.; Ozeroff, M. J. (RAND Corp., Santa Monica, CA). Nucl. Technol.; 22: No. 2, 229-236(May 1974).

The results of this study show that lightweight radioisotope heat sources can be considered for use undersea with little shielding necessary for electronics packages in close proximity to the heat source. Acceptable integrated electronic dose levels of 10^7 rad for gamma irradiation and 10^4 rep for neutron bombardment were obtained for extended mission times for the three isotopes considered. It is unnecessary to shield the isotope ^{210}Po for electronic

protection. However, use would be restricted because of its short half-life and this isotope could present special heat management problems not encountered with either ^{60}Co or ^{244}Cm. For ^{244}Cm and ^{60}Co it was found that the shield around the electronics package becomes important due to the strong backscattering effect of neutrons and gammas from the surrounding seawater. The ^{244}Cm heat source appears to require less shielding to electronics level and would therefore take up less volume in the undersea system than the ^{60}Co heat source. Recovery of an isotope-powered undersea electronics package must be done remotely. It will be necessary to provide shielding to protect personnel engaged in the retrieval of the package (and also in the initial launching) and this vehicle cask will also have to provide for auxiliary cooling of the radioisotope heating source. (auth)

3457 ATMOSPHERE-ENTRY BEHAVIOR OF A MODULAR, DISK-SHAPED ISOTOPE HEAT SOURCE. Vorreiter, J. W.; Burns, J. J.; Pitts, W. C.; Stine, H. A. (Ames Research Center, Moffett Field, CA). J. Spacecraft Rockets; 11: No. 5, 308-314 (May 1974).

The entry and impact behavior of an isotope heat source for space nuclear power that disassembles into a number of modules that would enter the Earth's atmosphere separately if a flight aborted were studied. These modules are disk-shaped units, each with its own reentry heat shield and protective impact container. In normal operation, the disk modules are stacked inside the generator, but during a reentry abort they separate and fly as individual units of low ballistic coefficient. Flight tests at hypersonic speeds have confirmed that a stack of disks will separate and assume a flat-forward mode of flight. Free-fall tests of single disks have demonstrated a nominal impact velocity of 30 m/sec at sea level for a practical range of ballistic coefficients. Thermal and structural calculations indicate reentry survival under all possible reentry conditions for speeds up to and including Earth escape speed. (auth)

3458 CARDIAC PACING: AN ENDLESS FRONTIER. Furman, S. Med. Instrum. (Arlington); 7: No. 3, 168-169(1973).

A brief review of cardiac pacemakers is presented. The use of electronic stimulation of other tissues is also discussed. (TFD)

3459 RADIOISOTOPE FUELED HEAT TRANSFER SYSTEM. Sparber, F. J.; Whiting, G. H. (to United States Atomic Energy Commission). US Patent 3,801,446. Apr 1974. Filed date 5 Jun 1968. 6p.

A heat transfer system is described for supplying a constant temperature to a heat utilization device including a heat transfer pipe having the utilization device mounted intermediate an alpha emitting radioisotope fuel for vaporizing the working fluid of the heat pipe and a heat exchanger for dissipating excess heat from the condenser portion of the heat pipe, means for retaining helium generated by the radioisotope fuel and a passageway for transporting the helium to the interior of the heat pipe to maintain constant the internal pressure and vaporization temperature of the working fluid within the heat pipe as the rate of heat dissipation from the radioisotope decreases. (Official Gazette)

3460 USE OF NUCLEAR-ENERGY POWERED PACEMAKERS FOR TRANSVENOUS ENDOCARDIAL STIMULATION. Rosenkranz, K. A. (Berufsgenossenschaftlichen Krankenanstalten Bergmannsheil, Bochum, Ger.); Schaldach, M. Deut. Med. Wochenschr.; 98: No. 47, 2227-2233(Nov 1973). (In German).

Using nuclear-powered implanted pacemakers, 16 patients have so far been paced using a transvenously introduced hook-electrode. Ten were P-wave triggered, six were demand pacemakers. Results so far, especially with the former type, are encouraging. Long-term observations will be required to see whether this type of pacemaker functions successfully for longer periods of pacing. Further development of biological sources of energy for pacemakers is required to provide as wide a spectrum of types as is possible. Furthermore, it is necessary to develop new forms of stimulating electrodes in order to reduce the large amount of energy which is now being used in electrochemical reactions. (GE)

3461 RECOMMENDATIONS FOR THE LICENSING AND SURVEILLANCE PROCEDURES FOR THE HANDLING OF RADIONUCLIDE SOURCES IN CARDIAC PACEMAKERS (AS OF SEP 27 1973). Gemeinsames Ministerialbl., A; 24: No. 28, 509-511 (Nov 1973). (In German).

Legal provisions (Radiation Protection Ordinance, Medicaments Decree), conditions regarding licensing (radiation protection responsibility, terms of financial security), special licensing conditions (radiation protection responsibility, terms of financial security), special licensing conditions (NEA, PTB, BAM, BGA) regarding radioisotope-powered cardiac pacemakers are discussed. (GE)

3462 CONTAINMENT OF Pm_2O_3 AND PROMETHIUM METAL AT ELEVATED TEMPERATURES. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, WA). pp 283-304 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

The use of promethium as the fuel in a radioisotopic heat source requires a knowledge of the compatibility of the promethium fuel form with containment materials at the temperature under consideration. Current indications are that Pm_2O_3 will be the preferred fuel form for most applications; with the possibility that promethium metal may find some use. Compatibility studies of Pm_2O_3 and Pm metal with various container materials are reported. (TFD)

3463 FABRICATION OF PROMETHIUM SOURCES. Jarrett, J. H.; Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, WA). pp 337-360 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

At PNL approximately 1030 g of Pm_2O_3, representing 281 watts-thermal, have been used in fabricating 52 sources. Significant quantities of promethium have been fabricated into sources at other laboratories, including about 500 g at the D. W. Douglas Laboratories (DWDL). Several techniques have been used to fabricate dense Pm_2O_3 shapes for the sources. Detailed information on both the oxide shape fabrication techniques, and the encapsulation techniques used in preparing various Pm_2O_3 sources is reported. The technology is given in sufficient detail to assist potential users in fabricating sources and in circumventing many of the problems involved. PNL sources were fabricated for use in the oxide-compatibility testing program, the in-phantom dosimetry studies, the ^{146}Pm-burnout studies, and in demonstrating various promethium applications. Applications utilizing thermal energy and radiation from promethium decay have been demonstrated. (auth)

Radiation Sources

Refer also to abstracts 3296, 3297, 3530, and 5219.

3464 PORTABLE X-RAY DIFFRACTOMETER FOR THE PHASE ANALYSIS OF MATERIALS HAVING A RADIATION SOURCE BASED ON ^{55}Fe. Bochenin, V. I. (Karaganda Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1569-1570(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 228-230(1973).

A diffractometer with a ^{55}Fe source which emits characteristic x radiation having $\lambda K_{\alpha_1} = 2.098$ Kx(Mn) is described. The focusing of the diffraction lines is accomplished according to the Bragg–Brentano method. The integral sensitivity of the lines is recorded by means of a one-channel "Mineral-3" amplitude analyzer. The results of using the instrument for the analysis of quartz in carbon dust are presented. The accuracy of the determination turned out to be on the same level as that of chemical analysis with an analysis rate of 3 to 5 min per sample. (auth)

3465 SAFETY TESTING OF RADIATION SOURCES. I. A Study on the Method of Contamination and Leakage Tests. Ohno, A. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan); Takishima, N.; Nojiri, T.; Maebashi, Y.; Maeda, S. Radioisotopes (Tokyo); 22: No. 7, 395-403(Jul 1973). (In Japanese).

Various kinds of contamination and leakage tests on sealed radioactive sources were carried out and noteworthy points were examined. The contamination tests using dummy radioactive source capsules consisted of wipe and soakage tests. In the wipe test, various kinds of plates and dummy radioactive source capsules were used. The soakage test was performed by use of dummy radioactive source capsules. Dummy capsules were artificially impaired to perform following leakage tests. Leak tests with lithium chloride, leakage tests in vacuum, pressure tests (test for measuring the increase of the weight in capsule), bubble tests, and helium tests (helium leak test and helium bubble test) were performed. In addition, contamination and leakage tests were performed using radiation sources of 1 μCi of ^{241}Am, 0.075 μCi of ^{226}Ra, and 10 mCi of ^{63}Ni. The results are summarized in tables. In order to examine the contamination and leakage using ^{3}H, radioactive sources of ^{3}H targets for neutron generators were used, and solid leakage tests (pressed adhesion test and strip test by cellophane tape) and tritium gas leakage test (temperature and pressure test) were performed, as well as the application of those tests used in general sealed radioactive sources. (JA)

3466 STANDARDS FOR ACTIVITY MEASUREMENTS OF SEALED SOURCES. Dryak, P.; Kits, J. (Ustav pro Vyzkum,

Vyrobu a Vyuziti Radioisotopu, Prague). Radioisotopy; 14: No. 6, 1021-1025(1973). (In Czech).

A cylindrical 4π ionization chamber is described, which together with a set of precise Ra-standards, serves for secondary standardization of radionuclides in the Institute for Research, Production and Application of Radioisotopes (ÚVVVR). The range of the described device is 1 μCi to 100 Ci and the accuracy of the relative measurements is 0.1% for activities higher than 50 μCi. The calibration techniques and the employed set of Ra-standards are described. For activities greater than 100 Ci, a portable "Substandard Baldwin Dosemeter" with a collimator is used as reference instrument and the activity is determined from the exposure rates of the standard and of the source. For flux measurements of neutron sources a long counter with an internationally compared ÚVVVR neutron flux standard is used. (auth)

3467 EXPERIENCE ON THE FIELD OF MEASUREMENT OF SEALED SOURCES. Kits, J.; Dryak, P.; Stopek, K. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague). Radioisotopy; 14: No. 6, 1015-1020(1973). (In Czech).

Activity measurements and leak tests of sealed sources are performed before shipping by the Institute for Research, Production and Application of Radioisotopes (ÚVVVR). The following leak tests are employed: (a) extraction method: the activity of the extract is determined with an internal GM-counter, proportional counter or by means of liquid scintillators; (b) emanation method: the emanation of Ra-sources is adsorbed on activated charcoal and counted; and (c) special methods: special methods are used for sources containing ^{85}Kr etc. The calibration and control of measuring instruments is performed with the use of appropriate ÚVVVR standards. (auth)

Design and Fabrication

3468 TECHNIQUE OF PREPARATION OF ^{32}P β-APPLICATOR AND ASSOCIATED RADIATION SAFETY DEVICES FOR STUDIES OF RADIATION BURNS IN ANIMALS. Jain, M. P.; Zutshi, D. N.; Nagpal, K. K.; Nayak, N. A. (INMAS, Delhi). Indian J. Med. Res.; 60: No. 8, 1181-1185(1972).

The indigenous preparation of a ^{32}P applicator capable of delivering a surface dose of around 30,000 rads/hr uniformly over a circular area of radius 1 cm is described. Special consideration has been given to the safety aspects during handling and use of the applicator. (Indian Sci. Abstr.)

3469 DEVELOPMENT OF ISOTOPIC RADIOGRAPHY METHODS. Maiorov, A. N.; Sul'kin, A. G.; Firstov, V. G. (All Union Scientific-Research Inst. of Radiation Tech., Moscow). Isotopenpraxis; 9: No. 10, 341-347(Oct 1973). (In Russian).

The development of isotopic sources for nondestructive radiography in USSR and the calibration of these devices is outlined. The radioisotopes used and their nuclear characteristics are tabulated. The optimization of the operation of isotopic sources is discussed. The time for the radiographic inspection for different types of sources is calculated and the results are tabulated. (JSR)

Industrial Uses

Refer also to abstracts 2728–2730, 2732, 2733, 2736, 2737, 3510, 3511, 3529, and 3540.

3470 CALIFORNIUM-252 PROGRESS. Californium-252 Progr.; No. 16, 1-53(Dec 1973).

Progress is reported on the use of ^{252}Cf in radiotherapy, neutron radiography, natural resources exploration, process control, neutron activation analysis, and radiometric gages. (TFD)

3471 INDUSTRIAL APPLICATIONS OF RADIOACTIVE TRACERS. Settipani, A. (Societe Qualitest, Levallois-Perret, France). pp 73-80 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Radioactive tracer techniques were developed after ordinary tracer techniques, and have enlarged the domain of applications. Such tracers are perfectly assimilated by fluids and can be detected using techniques other than visual observation. The use of radioactive tracers for flow measurements, air renewal rate measurements, and leak detection are discussed. Industrial criteria based on real experiments are defined. The principal techniques used are examined in each particular case together with the advantages and disadvantages of the method adopted. (FR)

3472 METHOD OF SECRETLY MARKING A SURFACE EMPLOYING FISSION PRODUCTS. Wing, J. (to United States Atomic Energy Commission). US Patent 3,805,067. Apr 1974. Filed date 14 Aug 1973. 4p.

A method of secretly marking or placing intelligence on the surface of an article in such a manner that the markings are undetectable by ordinary methods is described. This is accomplished by embedding in the surface to be marked a small amount of recoil fission products from a spontaneously fissioning radioisotope. These fission products have a very low radioactivity, cause no radiation damage to the article so marked, are detectable only by very sensitive radiation detectors, and the intelligence is discernible only by a radioautographic means. (Official Gazette)

3473 NUTRITIONAL QUALITY OF IRRADIATED FOODS. Raica, N. Jr.; Scott, J.; Nielsen, W. (Fitzsimmons General Hospital, Denver). Radiat. Res. Rev.; 3: No. 4, 447-457(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Representative data on the nutritional quality of irradiated foods are presented and some of the possible problem areas are brought into focus. Rad appertization at low temperatures greatly improves the nutritional quality in regard to the micronutrients studied. (LK)

3474 CHEMICAL CHANGES IN IRRADIATED SEAFOODS. King, F. J.; Mendelsohn, J. M.; Gadbois, D. F.; Bernsteinas, J. B. (National Oceanic and Atmospheric Administration, Gloucester, MA). Radiat. Res. Rev.; 3: No. 4, 399-415(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

The chemical changes in the volatile components, free amino acids, fatty acids, and nutrients of irradiated seafoods are reported. (75 references) (LK)

3475 FACTORS RELATED TO MARKET LIFE EXTENSION OF LOW DOSE IRRADIATED FRESH MEAT AND POULTRY. Urbain, W. M.; Giddings, G. G. (Michigan State Univ., East Lansing). Radiat. Res. Rev.; 3: No. 4, 389-397(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

Problems in the marketing and production areas which are not technical in nature and which must be solved in order for centralized cutting to come about are discussed. Changes in meat during storage and development of market life extension are treated. (LK)

3476 PROCESS FOR SUBJECTING WOOD CHIPS TO IRRADIATION WITH ELECTRONS. Free, D. (to Radiation Development Co., Ltd.). US Patent 3,801,432. 2 Apr 1974. Filed date 7 Feb 1972. 8p.

In the making of pulp from wood, wood is subjected to irradiation with electrons in an amount less than 1.0 megarad but sufficient to modify wood structure such that pulping process is facilitated by energy requirement reduction, and yield and quality of pulp obtained or improved. (Official Gazette)

3477 DETERMINING THE DEGREE OF CLEANING MILK UTENSILS AND EQUIPMENT USING ISOTOPE TECHNIQUES. Vrigazov, A.; Gromkov, N.; Dimov, G.; Todorov, D.; Stoyanov, S. Vet. Med. Nauki (Sofia); 10: No. 1, 15-24(1973). (In Bulgarian).

^{32}P-labelled sodium phosphate and ^{32}P-labelled suspension of St. aureus-M and E. coli-5 were used to contaminate bottles with milk, containers with yogurt, rubber hoses, and pieces of sheeting and dungaree. The effect of washing and disinfection was demonstrated by radiometric, autoradiographic, and microbiologic techniques. The microbiologic study of the washings from containers following cleaning treatments showed no test organisms. Radiometrically, the washings from some of the containers, especially after the contamination of the latter with St. aureus suspensions, showed negligible radioactivity. The autoradiograms, more often from big yogurt containers, rubber hoses, and in single cases from bottles and jars, showed certain degrees of contamination—from single traces to large foci of residual radioactivity. This points to the fact that the mechanical washing procedures do not always prove effective in eliminating the dirt from the containers. (auth)

3478 GENERAL SURVEY OF IRRADIATED FOOD PRODUCTS CLEARED FOR HUMAN CONSUMPTION IN DIFFERENT COUNTRIES. Isotopenpraxis; 9: No. 10, 374-375(Oct 1973). (In German).

The fruits, vegetables, grains, grain products, and meat cleared for human consumption after irradiation are tabulated. (JSR)

3479 PROMETHIUM APPLICATIONS REVIEW. Jarrett, J. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 361-376 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Promethium has been used for a variety of applications utilizing either the radiation or thermal energy resulting from its decay to stable samarium. These applications are reviewed to provide an overview to the uses of this radioisotope. The reader is referred to the indicated references and the other chapters of this book for detailed information on specific applications. (auth)

3480 PURIFICATION OF ^{85}Kr RADIATION SOURCE. Ootsuka, N.; Yamamoto, T. (Japan Atomic Energy Research Inst., Takasaki). Nippon Genshiryoku Gakkaishi; 16: No. 1, 47-55(Jan 1974). (In Japanese).

In β-irradiation facilities using unsealed ^{85}Kr gas as internal radiation source for chemical reactions in the liquid phase, it is necessary to remove chemically active gases from mixtures containing ^{85}Kr impurities. Gas purification equipment has been devised for the ^{85}Kr radiation source. The purification is achieved by removing O_2 and N_2 impurities with activated CuO and Ca, respectively. The equipment and the experimental results obtained therewith on the purification of a 100 Ci ^{85}Kr source is discussed. It is shown that purification of the ^{85}Kr source is possible with this equipment, and the purified ^{85}Kr gas can be used repeatedly as radiation source for chemical reactions. (auth)

LIFE SCIENCES

3481 (AD-766796-7) ANNUAL RESEARCH REPORT, 1 JULY 1971–30 JUNE 1972. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). 30 Jun 1972. 97p. (AFRRI-ARR-6). NTIS $3.75.

Problems in radiation biology remained a major part of the research program during this period, and the results of research done in these areas constitute the majority of this report. The new nuclear medicine and radiopharmaceutical program is reported, in part, and other aspects of the new program will be covered in future annual reports. (GRA)

3482 (AECL-4765) BIOLOGY AND HEALTH PHYSICS DIVISION. Progress Report, October 1–December 31, 1973. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1974. 99p. (PR-B-100). Dep. NTIS (US Sales Only) $8.00. AECL $2.00.

A list is included of 63 publications during the three-month period covered by this report that present results of studies completed. Brief summaries are presented of progress in current studies. In the fields of molecular biology and biochemistry, studies include the mechanisms for induction and repair of radioinduced injuries to DNA; the genetic control of radioinduced mutations in yeasts, bacteriophages, and insects; and the ecology of insect pests (black flies and mosquitoes). Studies on tumor induction in mammals include the synergistic effects of various environmental factors and doses of 1600 to 12,800 rad β radiation on the induction of neoplasms in rats and computerized data acquisition systems for epidemiological studies on human populations to evaluate the relationship of radiation exposure during diagnostic radiography to the incidence of neoplasms, congenital malformations, and genetic diseases. Environmental studies include radiation monitoring of environmental samples collected in the environs of the Chalk River Nuclear Laboratory (Canada) including γ surveys of soil surfaces, measurements of radioactivity from radionuclides in surface air, precipitation, mosquitoes, water samples from Perch Lake and the St. Lawrence River, and the content of ^{60}Co, ^{90}Sr, and tritium in samples of biota and water from Perch Lake. The performance of thermoluminescent dosemeters, semiconductor detectors, ionization chambers, and neutron dosemeters is discussed. (CH)

3483 (CONF-720724-P1, pp 558-564) PLASTIC TRACK DETECTORS IN THE BIOSTACK EXPERIMENT M-211 ON BOARD OF APOLLO 16. Enge, W. (Univ., Kiel); Bartholomae, K. P.; Besujean, R.; Heinrich, W.; Fukui, M.; Horneck, G.; Buecker, H. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The Biostack experiment M-211 is a collaboration of biological and physical institutes in Europe. The Biostack consists of more than 200 layers of biological material and physical detectors like plastics and nuclear emulsions. Applying plastic detectors a new method has been developed to correlate single heavy cosmic ray particles with single biological objects to study the radiation effects of these particles on biological systems. The method is described. It was checked in accelerator and balloon borne experiments. First results of the Biostack experiment on board of Apollo 16, launched on April 16, 1972, are reported. (auth)

Radiation Effects on Biochemicals

Refer also to abstracts 2702, 2712, 2775, 3489, 3514, 3637, and 5765.

3484 CHOICE OF SOLVENT FOR STUDYING THE ROLE OF WATER IN IONIZING RADIATION ACTION ON DNA. Achey, P. M.; Duryea, H. Z.; Michaels, G. S. (Univ. of Florida, Gainesville). Radiat. Res.; 58: No. 1, 83-90(Apr 1974).

Two buffers that are commonly used in nucleic acid chemistry for maintaining the pH near neutrality are sodium phosphate and tris(hydroxymethyl)aminomethane, or Tris for short. The possible modifying action of these buffers on the sensitivity of DNA to radiation-induced strand breaks and biological inactivation has been studied. The results show that the sensitivity of the DNA is not altered by a change in concentration of sodium phosphate buffer (pH 7.1) between 0.005 M and 0.055 M, whereas the radiosensitivity of the DNA decreases when the concentration of Tris buffer (pH 8.0) is increased from 0.005 M to 0.055M. These results indicate that sodium phosphate is a good choice of buffer for dissolving DNA samples when performing radiation studies, since the sodium phosphate itself does not seem to influence radiosensitivity. (auth)

3485 EFFECT OF γ RADIATION ON THE CHARGE AND SIZE PROPERTIES OF HORSERADISH PEROXIDASE. Delincee, H.; Radola, B. J. (Bundesforschungsanslalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Radiat. Res.; 58: No. 1, 9-24(Apr 1974).

Horseradish peroxidase (EC. 1.11.1.7) was irradiated in dilute aqueous solution under argon with ^{60}Co γ rays. A G value of ~0.09 has been found, indicating that peroxidase is relatively resistant to ionizing radiation. Isoelectric focusing of the irradiated peroxidase revealed: a prevailing dose-dependent shift to components with lower isoelectric points and multiple new enzymatically active components. By thin-layer gel chromatography, formation of aggregates partially retaining enzyme activity was detected. Radiation-induced aggregation depended strongly on enzyme concentration; in diluted solutions much fewer aggregates were formed. Aggregation proceeded stepwise, the degree of polymerization increasing with dose. Noncovalent bonds and disulfide links appear to be involved in aggregation. Fragments smaller than the monomer have not been detected. The charge properties of the aggregates and remaining monomers, isolated from irradiated peroxidase by gel chromatography, were characterized by isoelectric focusing. The isoelectric patterns of the monomers revealed a sequence of degradation steps, indicating a pronounced dose-dependent modification of the monomeric enzyme. (auth)

3486 CHANGES IN COMPOSITION OF MINOR COMPONENTS OF tRNA IN DYNAMICS OF ACUTE RADIATION SICKNESS. Sopin, E. F.; Kucherenko, M. E.; Vasil'ev, O. M. (Kiev State Univ.). Ukr. Biokhim. Zh.; 46: No. 1, 88-91(1974). (In Ukrainian).

The nucleotide composition of total tRNA from the liver of guinea pigs was determined in norm and in dynamics of acute radiation sickness by the method of thin-layer DEAE-cellulose chromatography in combination with identification of the compounds by ultraviolet spectra. The performed studies resulted in finding essential changes in the nucleotide composition of tRNA. However, in dynamics of radiation sickness essential qualitative and quantitative changes were observed in the minor composition of total tRNA. The content of both methylated and nonmethylated minors changes. In the initial period of radiation disease the methylated minors are presented mainly by the methylated derivatives of guanine and during three, five, and seven days after irradiation by methylated derivatives of adenine. The content of the methylated derivatives decreases in dynamics of radiation sickness. (auth)

3487 EXCISION OF THYMINE DIMERS BY PROTEOLYTIC AND AMBER FRAGMENTS OF E. COLI DNA POLYMERASE I Friedberg, E. C.; Lehman, I. R. (Stanford Univ., CA). Biochem. Biophys. Res. Commun.; 58: No. 1, 132-139(7 May 1974).

Excision of thymine dimers from specifically incised uv-irradiated DNA by E. coli DNA polymerase I is stimulated by concurrent DNA synthesis. The 36,000 molecular-weight small fragment obtained by limited proteolysis of DNA polymerase I, which retains only the 5′ → 3′ exonuclease activity, also excises thymine dimers, but at one-tenth the rate of the intact enzyme. However, the rate of excision is increased by addition of the large 76,000-molecular weight fragment. With the further addition of the 4 deoxynucleoside triphosphates, permitting DNA synthesis to occur, excision approaches rates observed with the intact enzyme. The same result was obtained with a fragment of DNA polymerase I with 5′ → 3′ exonuclease activity that is present uniquely in polymerase I amber mutants. (auth)

3488 GAMMA-RAY INDUCED DAMAGE IN THYMINE IN MONONUCLEOTIDE MIXTURES, AND IN SINGLE- AND DOUBLE-STRANDED DNA. Swinehart, J. L.; Lin, W. S.; Cerutti, P. A. (Univ. of Florida, Gainesville). Radiat. Res.; 58: No. 2, 166-175 (May 1974).

Some of the factors expected to influence the radiation chemical reactivity of the nucleic acid bases in situ in the living cell were investigated. Two γ-induced reactions of thymine, the production of ^3H_2O from [^{3}H]thymine-methyl and of products of the 6-(hydroxy or hydroperoxy)-dihydrothymine type (t^*), were compared in mononucleotide mixtures, single-stranded ϕX174 DNA, and double-stranded Escherichia coli DNA. The initial rates of ^3H_2O and t^* formation were similar for the mononucleotide mixture and single-stranded DNA irradiated under nonprotective conditions. For native E. coli DNA the initial rates for ^3H_2O formation were lower by a factor of 9 and for the formation of t^* by a factor of 12 relative to ϕX174 DNA. The protective media in all cases suppressed the reactions of thymine more efficiently in the poly-

mer relative to the mononucleotide mixtures, e.g., the formation of t^r in tryptone–glucose–yeast extract medium was 67 times more efficient in the mononucleotide mixture than in E. coli DNA. (auth)

Radiation Effects on Cells

Refer also to abstracts 3637, 3638, 3666, and 5220.

3489 (ORO-2832-126) RADIATION AND BIOPHYSICAL STUDIES ON CELLS AND VIRUSES. Progress Report, October 16, 1972–February 28, 1974. Cole, A. (Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex. (USA)). 1974. Contract AT(40-1)-2832. 51p. Dep. NTIS $5.75.

Progress is reported in studies on the effects of ionizing radiation on mammalian cells and on viruses. Topics discussed in detail include: the organization of the genetic structure of chromosomes and nucleoproteins; the effects of γ and electron irradiation on cellular constituents with emphasis on DNA strand breaks and repair mechanisms; and the semiconductor properties of biomolecules and applications to melanin-containing cells. A list is included of 27 publications during the time period covered by this report that describe the findings in detail. (CH)

3490 EFFECT OF THE SECONDARY CHARGED-PARTICLE SPECTRUM ON CELLULAR RESPONSE TO FAST NEUTRONS. Bewley, D. K.; McNally, N. J.; Page, B. C. (Hammersmith Hospital, London). Radiat. Res.; 58: No. 1, 111-121(Apr 1974).

Rat fibrosarcoma cells were irradiated with fast neutrons of mean energy 7.5 MeV, in the presence and absence of secondary charged-particle equilibrium. In the latter condition the biological effect was produced only by the more densely ionizing secondary particles (α particles and heavy recoils) which gave an absorbed dose about 20% of the Kerma. This component of the radiation was found to give an oxygen enhancement ratio (OER) of 1.0 and an RBE of 7. The OER of the recoil proton component was almost the same as that of x rays, but the RBE was about 2.5. It is concluded that, if the dose is separated into two components, namely, recoil protons and more densely ionizing particles, both contribute about equally to the biological effect under aerobic conditions but the latter alone is responsible for the reduced OER. (auth)

3491 UNSCHEDULED DNA SYNTHESIS AFTER ULTRAVIOLET MICROIRRADIATION OF THE CELL NUCLEUS. Moreno, G.; Salet, C. (Hopital de Bicetre, le Kremlin-Bicetre, France). Radiat. Res., 58: No. 1, 52-59(Apr 1974).

Ultraviolet (uv) microirradiation of the cell nucleus was used to study the unscheduled DNA synthesis. Xeroderma pigmentosum (XP) fibroblasts and KB cells in tissue culture were microirradiated over one or more nuclear areas of 5 μm in diameter with uv doses of the order of 10, 100, 1000, and 2000 ergs/mm^2. After the irradiation, the cells were labeled with ^{3}H-thymidine (^{3}HTdR) for 3 hr and autoradiographed. In XP cells not in S phase, no ^{3}HTdR uptake was detected under these conditions, but in KB cells an incorporation localized over the irradiated area(s) of the nucleus was observed. XP and KB cells in S phase during the labeling time, microirradiated with doses of the order of 10 or 100 ergs/mm^2, were labeled throughout the nucleus, but cells irradiated with a dose of the order of 1000 ergs/mm^2 showed a lower incorporation at the irradiated area than in the nonirradiated part of the nucleus. In addition, when the irradiated area of the KB cell nucleus was increased by irradiating several spots (two and four) with the same uv dose per unit area, the average number of grains per irradiated area decreased. No modification of the unscheduled DNA synthesis was detected after partial irradiation of the cytoplasm. (auth)

3492 ANALYSES OF DIFFERENTIAL SENSITIVITIES OF SYNCHRONIZED HeLa S3 CELLS TO RADIATIONS AND CHEMICAL CARCINOGEN DURING THE CELL CYCLE. II. Ultraviolet Light. Watanabe, M.; Horikawa, M. (Kanazawa Univ., Japan). Biochem. Biophys. Res. Commun.; 58: No. 1, 185-191(7 May 1974).

UV-induction of thymine dimers in cellular DNA and their excision during different phases of the cell cycle of HeLa S3 cells were studied. Induction of thymine dimers was higher in the mitotic phase and the middle of the S phase than in the G_1 phase and from the late S phase to the early G_2 phase which are rather insensitive to uv. However, there is no significant difference in excision rate of uv-induced thymine dimers from the irradiated cells through the cell cycle. These findings indicate that the cyclic variation of uv-survivals during the cell cycle may be due to differences in the amount of thymine dimers in cellular DNA induced by uv irradiation. (auth)

3493 THERMALLY ENHANCED RADIORESPONSE OF CULTURED CHINESE HAMSTER CELLS: INHIBITION OF REPAIR OF SUBLETHAL DAMAGE AND ENHANCEMENT OF LETHAL DAMAGE. Ben-Hur, E.; Elkind, M. M.; Bronk, B. V. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 58: No. 1, 38-51(Apr 1974).

X irradiation of Chinese hamster cells at temperatures above 37°C results in enhanced killing response. The magnitude of this thermal effect increases with increasing temperature and varies inversely with dose rate during the exposure of the cells to the combined effects of elevated temperature and ionizing radiation. Postirradiation incubation at an elevated temperature is also effective in enhancing the response but not preirradiation hyperthermia. Split-dose experiments demonstrate that hyperthermia also inhibits the repair of sublethal damage for temperatures up to ~41°C. Above 41°C, lethal damage expression is enhanced as well. Fluctuations in the age-response structure of cells x-irradiated at 42°C are reduced, a result consistent with a reduced capacity for sublethal damage when cells are hyperthermic during irradiation. (auth)

3494 DEISTVIE IONIZIRUYUSHCHEGO IZLUCHENIYA NA KLETOCHNYE MEMBRANY. (Action of Ionizing Radiation on Cell Membranes). Kuzin, A. M.; Pavlovskii, T. E. Moscow; Atomizdat (1973). 112p. (NP-19990).

Five papers presented at the First All-Union Symposium on the Action of Ionizing Radiation on cell membranes (Pushchino on the Oka, 1970) are included. The results of experimental studies made in the USSR and current problems in radiobiology are reviewed. Topics discussed in detail include: the effects of ionizing radiation on the physico-chemical properties of cell membranes; effects of radiation on the penetrability of cell surface membranes, the relation of enzyme activity to ion transport mechanisms and injuries to membranes of intracellular organelles; possible mechanisms of radiation injury to erythrocyte membranes and radioinduced ultrastructural changes in nerve cell membranes; and the relationship between the radiosensitivity of bacterial cells and membrane penetrability. (294 references) (tr-auth)

3495 STUDIES OF THE EPSTEIN–BARR VIRUS–HOST RELATIONSHIP: AUTOCHTHONOUS AND ALLOGENEIC LYMPHOCYTE STIMULATION BY LYMPHOBLAST CELL LINES IN MIXED CELL CULTURE. Bausher, J. C.; Smith, R. T. (Univ. of Florida, Gainesville). Clin. Immunol. Immunopathol.; 1: 270-281 (Jan 1973).

The capacity of 21 established human lymphoblast cell lines to stimulate DNA synthesis in peripheral blood leukocyte populations of autochthonous or allogeneic origin was compared in one-way mixed lymphocyte cultures. Strong stimulation in the autochthonous combination was found in 20 out of 21 pairs, and weak but significant stimulation was observed in the exceptional pair. Allogeneic pairs gave additional increments of stimulation over that of the autochthonous pair in 21 out of 31 pairs tested. The observed stimulation was shown not to be due to a secreted blastogenic agent. The data support but do not prove that EBV-related antigens are responsible for the observed stimulation. This implies the existence of an EBV-immune cell population recognizing specific antigens in the target cell membrane. Effects of gamma radiation and mitomycin C in blocking DNA synthesis in target cells were compared. (HLW)

3496 MINIATURIZED MOUSE MIXED LEUKOCYTE CULTURE IN SERUM-FREE AND MOUSE SERUM SUPPLEMENTED MEDIA. Peck, A. B.; Bach, F. H. (Univ. of Wisconsin, Madison). J. Immunol. Methods; 3: 147-163(Oct 1973).

A miniaturized version of the mouse mixed leukocyte culture utilizing serum-free and mouse serum supplemented media is described. Parameters that optimize cellular responses of mouse spleen cells against alloantigens are defined. (auth)

3497 AN IN VITRO ASSAY TO MEASURE THE VIABILITY OF KHT TUMOR CELLS NOT PREVIOUSLY EXPOSED TO CULTURE CONDITIONS. Thomson, J. E.; Rauth, A. M. (Univ. of Toronto). Radiat. Res.; 58: No. 2, 262-276(May 1974).

An in vitro colony assay, which measures the viability of KHT fibrosarcoma cells, is described. Single cell suspensions are prepared from tumors growing in C3H mice with no previous adaptation for in vitro growth. The assay involves incubating cells at 37°C for 2 wk in Petri dishes containing a semisolid matrix of α medium, fetal calf serum, and Bacto agar. Colonies containing 20 or more cells are then counted under a microscope. The plating efficiency of the assay ranges from 5 to 40% based on the number of viable cells plated as determined by dye exclusion. However, this dye-exclusion technique may overestimate the number of viable cells since the plating efficiency of cells separated by velocity sedimentation ranges from 50 to 90%. Survival curves have been determined for cell suspensions irradiated in vitro in air or nitrogen. D_0's of 167 and 478 rads and extrapolation numbers of 1.6 and 1.4 were obtained for aero-

bic and anoxic curves, respectively. These numbers are in reasonable agreement with previous values obtained for this tumor by others using in vivo assays. Survival curves for tumors irradiated in vivo and assayed in vitro or in vivo are also in good agreement. (auth)

3498 CELLULAR RADIOSENSITIVITY OF A CULTURED MOUSE OSTEOSARCOMA SUBLINE DERIVED FROM A TRANSPLANTABLE TUMOR, TO DIFFERENT IONIZING RADIATIONS. Nelson, J. M. (Radiobiological Inst. of the Organization for Health Research TNO, Rijswijk, Netherlands). Radiat. Res.; 58: No. 2, 209-218(May 1974).

The in vitro subline 23022, derived from the transplantable mouse osteosarcoma C22RL may be serially maintained and assayed for surviving fraction of clonogenic cells by standard in vitro techniques. The cells were found to grow satisfactorily as a monolayer in Eagle's medium supplemented with newborn calf serum. Details of the culture system and a critical evaluation of the assay techniques are discussed. Cultured cells retain transplantability and tumorigenic potential, as demonstrated by the development of rapidly progressing tumors following subcutaneous inoculation of cells into the appropriate mouse strain. Although technical difficulties have prohibited satisfactory evaluation of cloning efficiency or survival for cells dispersed directly from the in vivo tumor, untreated control cells suspended from culture demonstrate a cloning efficiency between 22 and 32%. In vitro techniques have been used to obtain cell sensitivity data for 300 kV x rays and 15 MeV neutrons, under both well-oxygenated and hypoxic conditions. Subsequent determination of various survival parameters, including OER and RBE values, has indicated a strong correspondence between this cultured subline and its parent tumor. A high OER for neutrons of 1.8–2.0 obtained for the subline agrees closely with that determined by endpoint dilution titration techniques for the parent tumor, establishing this as a cellular parameter, independent of the in situ environment. (auth)

3499 BIOLOGICAL EFFECT OF FAST NEUTRONS NOT IN CHARGED-PARTICLE EQUILIBRIUM. Bewley, D. K.; McNally, N. J.; Page, B. C. (Hammersmith Hospital, London). pp 97-108 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Cells from a rat tumor have been exposed in vitro to a cyclotron-produced fast neutron beam of mean energy 7.5 MeV under conditions of full and minimum secondary charged-particle equilibrium. The cells were plated on Melinex discs and covered with tissue-equivalent plastic or aluminium for the two situations. When no recoil protons were present an oxygen enhancement ratio of 1.0 was found. The dose and quality of the radiation absorbed by the cells has been estimated by calculation and measurement with an ionization chamber. The dose from recoil protons increases very rapidly under the first few microns of tissue, which limits the accuracy of RBE values obtainable. Nevertheless estimates of RBE and OER have been made for the partial doses of recoil protons and heavier ions. The heavier ions were found to have a higher RBE than the recoil protons, particularly under hypoxic conditions. This technique of irradiation with fast neutrons containing a minimum contribution from recoil protons enables the experimenter to use a very densely ionizing type of radiation without having access to a beam of charged particles. (auth)

3500 ENERGY DEPOSITION ON A MICROSCOPIC SCALE, RELEVANT TO THE BIOLOGICAL EFFECTS OF FAST NEUTRONS. Report on the Fourth EURATOM Symposium on Microdosimetry. Booz, J. (EURATOM, Ispra, Italy). pp 119-130 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Energy deposition on a microscopic scale, the biological effectiveness of fast neutrons, and radiation mechanisms are discussed. A brief introduction to the physical and biological background of microdosimetry is given. (auth)

3501 THEORETICAL ANALYSIS OF RADIATION SENSITIVITY IN CELLS FOLLOWING NEUTRON IRRADIATION. Leenhouts, H. P.; Chadwick, K. H. (EURATOM-ITAL, Wageningen, Netherlands). pp 151-163 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

There is increasing experimental evidence that the critical molecule in radiobiology is the DNA double helix. Recently a molecular theory has been developed starting from the assumption that double-strand breaks in the DNA are the most critical lesions for cell killing. This theory is applied to all types of ionizing radiation and thus neutrons as well as γ or x radiation are assumed to cause the same type of primary damage. The difference between the neutron and γ radiation effect is explained in the theory by the different way in which these radiations induce the double-strand breaks. Another biological end point that can be associated with damage to the DNA in a cell is a somatic mutation. If it is assumed that a DNA double-strand break is the most critical radiation-induced lesion that can lead to a somatic mutation, a general equation can be derived for the induction of mutations by radiation. The theoretical equations are compared with data in the literature for neutron and γ or x radiation for the two phenomena. The implications of the theoretical considerations for plant-mutation breeding and the sterile-male technique are discussed with respect to the optimization of the process required. (auth)

3502 RELATIVE EFFECTIVENESS OF VARIOUS KINDS OF MIXED GAMMA AND NEUTRON RADIATION AS REGARDS THE IN VITRO INDUCTION OF CHROMOSOMAL ANOMALIES IN HUMAN LYMPHOCYTES. Biola, M. T.; Le Go, R.; Vacca, G.; Ducatez, G.; Dacher, J.; Bourguignon, M. (CEN, Fontenay-aux-Roses, France). pp 221-236 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974). (In French).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The in vitro induction of dicentric chromosomes was studied for several kinds of mixed γ and neutron radiations: the mixed radiation emitted during criticality studies where a solution of an enriched uranium salt is introduced into a tank (CRAC experiment; flash irradiation); and the relatively pure neutron radiation produced behind a steel plate when the Harmonie reactor goes critical (continuous fluence rate). The energy spectra, the fluences, and the ratio of the dose from the neutron component to the dose from the γ component varied appreciably from one type of source to another and from one experiment to another. The results appear to confirm the assumption that the effects of the γ component and the neutron component are additive. On the basis of the additivity assumption it was possible to compare the dose-effect relationships obtained for the neutron components with the dose-effect relationship obtained for ^{60}Co γ radiation. The comparison made it possible to estimate the relative biological effectiveness of the neutrons and showed clearly the influence of certain physical characteristics of the various kinds of radiations. (auth)

3503 EFFECT OF DIFFERING NEUTRON ENERGIES ON MUTAGENESIS IN CULTURED CHINESE HAMSTER CELLS. Richold, M.; Holt, P. D. (Atomic Energy Research Establishment, Harwell, Eng.). pp 237-244 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Using Chinese hamster cells, the effects of a range of neutron energies on cell survival and cell mutation were examined. The mutation assay used was that of resistance to high levels of the purine analogue 8-azaguanine. Gamma radiation ^{60}Co was used as a reference in these studies. Provisional values of relative biological efficiency (RBE) for cell survival and cell mutation are presented for (d,T) neutrons (15 MeV), (d,d) neutrons (4.6 MeV), and for three broad spectra, with energies extending up to 6, 9, and 15 MeV respectively, obtained from deuteron reactions with beryllium. The relevance of these studies to radiological protection norms is briefly discussed. (auth)

3504 LETHAL EFFECTS OF 14-MeV FAST NEUTRONS ON FROG EGGS AND CULTURED MAMMALIAN CELLS. Takeshita, K.; Sawada, S. (Hiroshima Univ.). pp 245-255 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

To study the effect of fast neutrons on the cell cycle of developing frog embryos, Rana nigromaculata and Rana japonica eggs were artificially inseminated with their own sperm and irradiated with 180-kV x rays or 14-MeV neutrons at various times after insemination. Normal survivors were counted on the hatching stage as a criterion. When R. nigromaculata eggs were irradiated with 60 rads of x rays the cell-cycle dependency of their radiosensitivity was established. A similar pattern was also found for

R. japonica eggs after 100 rads of x irradiation. When R. nigromaculata eggs were irradiated with 25 rads of neutrons the survival rate at the second resistant stage was reduced and the subsequent cyclic response became irregular. The dose response to x rays and neutrons at the first sensitive stage and the second resistant stage of R. japonica eggs was examined. It was found that the RBE, D_0 ratio of neutrons to x rays was higher (3.0) in the resistant stage than the sensitive stage (1.2). It appears that 14-MeV neutrons are incapable of flattening the stage dependency of radiosensitivity in developing frog eggs. Using L5178Y cultured mouse leukemic cells, the lethal effects of neutrons were compared with those of x rays for colony-forming ability in both the exponentially and stationary growing cells, at normal and very low temperatures. From dose-survival curves it was concluded that, in both exponential and stationary growth phases, the D_0 dose of cells irradiated in the frozen state was higher than that incurred at 37°C, but there were no significant differences among the D_0 doses to the cells irradiated at −15, −78 and −196°C. However, freezing the cells increased the RBE values of neutrons as compared with x rays in both growth phases. The sensitivity of the stationary growing cells to x rays at 37°C, on the other hand, was found to be lower than that of the exponentially growing cells and this difference became more apparent in cells irradiated in the frozen state. However, there was little difference between the two growth phases as to their sensitivity to neutrons, either at 37°C or in the frozen state. (auth)

3505 MODIFICATION OF NEUTRON EFFECTS UPON CELLS BY REPAIR, AND BY PHYSICAL AND CHEMICAL MEANS. Berry, R. J. (Churchill Hospital Research Inst., Oxford). pp 257-271 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The effects of neutron energy, dose rate, dose fractionation, the presence or absence of oxygen, and interactions with pharmacological agents on the reproductive capacity and postirradiation growth of neutron-irradiated mammalian cells are reviewed. There appear to be only quantitative, not qualitative, differences between the effects of x or γ rays and those of the more energetic fast neutrons being used or proposed for radiotherapy of human cancer. The most striking differences emerge from the effects of fast neutrons of relatively low energy (≳1 MeV) such as those from ^{235}U fission spectra. (auth)

3506 RESPONSE OF MOUSE LEUKEMIC CELLS AFTER IRRADIATION WITH X-RAYS AND FAST NEUTRONS. Broerse, J. J.; Van Oosterom, P. M. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 275-282 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The response of cultured mouse leukemic cells was investigated for in vitro irradiation with 15-MeV neutrons and 300-kV x rays carried out under oxygenated and hypoxic conditions. A thin-layer agar technique, employing mouse embryo fibroblasts as a feeder layer, was applied to measure the reproductive capacity of the leukemic cells after irradiation. For single-dose in vitro irradiations under well-oxygenated conditions an RBE value of 1.5 was obtained at a surviving fraction of 10^{-3}. The biological results are discussed in relation to the available data for other types of experimental tumors. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 3252, 3478, 3529, 3549, 4076, 5770, and 5771.

3507 (CONF-720486-) 1972 PROCEEDINGS OF THE RADIOISOTOPE SOCIETY OF THE PHILIPPINES, INC. AND THE PHILIPPINE SOCIETY OF NUCLEAR MEDICINE, JOINT ANNUAL CONVENTION, QUEZON CITY, PHILIPPINES, APRIL 7, 1972. (Radioisotope Society of the Philippines, Manila). 1972. 59p.

Separate abstracts were prepared for five of the six full length papers presented in these proceedings. An abstract of the other paper was previously published in volume 28 of NSA as abstract number 12623. Five other papers are represented by abstracts only. (ERB)

For abstracts of individual papers see: 2787, 2788, 3529, 3675, and 3701.

3508 (CONF-720724-P1, pp 545-557) BIOSTACK EXPERIMENT M211: APOLLO 16. Kaiser, R.; Pfohl, R.; Massue, J. P.; Schmitt, R.; Cuer, P. (Laboratoire de physique corpusculaire, Strasbourg-Cronenbourg, France). 1972. (In French).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The biostack experiment M211 consisted of more than 200 layers of biological material and detectors. Spores of Bacillus subtilis, seeds of Arabidopsis thaliana, Vicia faba radiculae and embryos, and Artemia salina eggs were the biological materials used. The experimental method used for the correlation between the heavy ion tracks and the position of the biological objects is described in detail. The determination of the energy released in the biological objects is discussed. (JSR)

3509 DEATH RATE OF LYSOGENIC BACTERIA AFTER ULTRAVIOLET INDUCTION FOLLOWS GOMPERTZ'S LAW. Murphy, J. S. (Rockefeller Univ., New York). Mech. Ageing Develop.; 2: 125-139(1973).

After ultraviolet induction of Bacillus megaterium 899a, both the rate of bacteriophage release and the rate of bacterial lysis increase with kinetics similar to those found in autocatalytic reactions. The virus-release curve may be measured over a span of five log units. Evidence is presented that this phenomenon is not mediated by information exchange among bacteria and, therefore, is not dictated by an extracellular autocatalytic reaction. The results show that the kinetics of death in induced cultures are similar to the kinetics of death found in higher organisms where the death rate increases exponentially with the age of the population (Gompertz's law). In other words, when a culture of lysogenic bacteria is induced, it acquires a defined lifespan and proceeds to die with kinetics obeying Gompertz's law. A possible mechanism is discussed in an attempt to explain the results at the molecular level. (auth)

3510 IRRADIATION OF DEHYDRATED FIGS AND PLUMS WITH DISINFECTANT DOSES: CHEMICAL AND MICROBIOLOGICAL ASPECTS. Belli Donini, M. L.; Baraldi, D.; Magaudda, G. Com. Naz. Energ. Nucl., Notiz.; 19: No. 12, 87-91(Dec 1973). (In Italian).

Dehydrated figs and plums were irradiated with doses of 30, 60, 300, and 600 R to eliminate the damage from insects and the possible modifications of the carbohydrates, β-carotene, vitamin B_1, and vitamin B_2 were studied. The results showed that irradiation is recommended for the disinfection of insects, particularly for figs. The doses applied did not cause appreciable modifications in the carbohydrates and vitamins of figs. The β-carotene content of plums was not decreased with radiation processing. (JSR)

3511 REGULATIONS GOVERNING THE APPROVAL OF IRRADIATED FOOD. Diehl, J. F. Verbraucherdienst; 15: 13-15 (1970). (In German).

A survey is given of the regulations governing the approval of irradiated food, discussing the Part IV issued by the Commission on Foreign Substances in Food of the Deutsche Forschungsgemeinschaft. Whereas there is no difficulty in detecting any residual radioactivity in the wrapping material, the wholesomeness of the food itself is far more difficult to demonstrate. The paper gives a description of the various possibilities and methods to prove the wholesomeness or harmfulness, respectively, of irradiated food by means of animal experiments, referring above all to the report of the Joint FAO/IAEA/WHO Expert Committee of 1964 (Rome Report). As far as similar materials are concerned, (such as wheat and rye) biotests of the same kind can be made, whereas considerably different experiments have to be carried out to investigate other foodstuffs as, e.g. onions and fats. There are essential differences in the attitude of the authorities of the several countries towards the findings of these animal experiments. The author mentions as an example the rejection of an application by the US army for the approval of irradiated ham, which has been rejected by the FDA,who found the experiments too unsatisfying to justify approval. Furthermore, some examples are given of irradiated foodstuffs that have been given approval, as for instance wheat in Canada, onions in Israel, and mushrooms in the Netherlands. (GE)

3512 CONTRIBUTION TO THE STUDY OF THE LYSOGENIC SYSTEM OF STAPHYLOCOCCUS ALBUS. Centeno, A. J. (Univ., Golas, Brazil). Rev. Brasil. Pesquis. Med. Biol.; 6: No. 3-4, 171-180(1973). (In Portuguese).

A mutant of Staphylococcus albus was studied with regard to its survival curve following uv and x irradiation. The data suggested that the radiosensitivity was related to a mutation or deletion in the prophage DNA. The effects of uv radiation and streptomycin on lysis caused by mutant phages are discussed. The relation of the radiosensitivity of the lytic enzyme to acceptors in the cell wall was examined. (HLW)

3513 INACTIVATION BY GAMMA RAYS OF BACILLUS MEGATHERIUM SPORES SUSPENDED IN AQUEOUS SOLUTIONS OF ETHANOL, ACETONE, AND 1,4-DIOXANE OF WIDELY VARYING CONCENTRATIONS. Stratford, I. J.; Tallentire, A.

(Univ. of Manchester, Eng.). J. Pharm. Pharmacol., Suppl.; 25: 130(Dec 1973).

Survival data were obtained for Bacillus megatherium spores suspended in aqueous solutions of ethanol, acetone, and 1,4-dioxane and γ-irradiated under oxygenated and deoxygenated conditions. For anoxic irradiation no effect on response, as measured by changes in slopes of linear dose/ln survival curves, is seen for concentrations of solutes below about 1 mol liter^{-1}. At concentrations of acetone and dioxane greater than 1 mol liter^{-1}, spores exhibit an increase in response with increasing agent concentration; the maximum increase (amounting to approximately 20 and 30% of the total response for dioxane and acetone respectively) occurs at concentrations of agents between 8 and 10 mol liter^{-1}. In contrast, ethanol at these high concentrations is without effect on response, although in pure ethanol a small but significant reduction in response is observed. For irradiation under oxygenated conditions the pattern of behavior for acetone and dioxane solutions is similar to that seen with spores irradiated in anoxia. Spores in aqueous solutions of ethanol, on the other hand, show no change in response with increasing concentration up to 15 mol liter^{-1}. The sharp transition in response seen at very high ethanol concentrations, occurring in different direction for oxic and anoxic spores, indicates that it is associated with dehydration of the spores. The progressive transition characteristic of acetone and dioxane over a relatively wide concentration range is suggestive that increases in response are due to lethal chemical events involving the agent itself. (UK)

3514 ULTRAVIOLET RADIATION TOXICITY AND REPAIR IN DNA OF HAY BACILLARY SPORES. Munakata, N. (Univ. of Texas, Austin). Hoshasen Seibutsu Kenkyu; 8: No. 3, 45-51(Sep 1973). (In Japanese).

The present condition of research on photochemistry and repair systems of DNA in spores is described, indicating that the resistance against ultraviolet radiation of hay bacillary spores was several times greater than nutritive cells. Ultraviolet irradiation of hay bacillary spores DNA produced 5-thyminyl-5,6-dihydrothymine (TDHT). Photochemical characteristics of TDHT are shown. The high production efficiency of TDHT may be caused by the death of spores from the ultraviolet radiation. The biological significance of spore formation is to maintain dormancy, and the structure of DNA changes accordingly. TDHT is removed from DNA by mechanisms of excision repair and spore repair. The first stage of these repairs was carried out by enzyme systems accumulated in spores. This study analyzed the ultraviolet susceptibility of spores in mutant gene strains, such as rec, pol, and tsp, as well as excision repair and spore repair. It was revealed that excision repair contributes to ultraviolet resistance of spores, that hcr and pol genes are related to excision repair and that ssp_1 and rec A_1 genes are related to spore repair. Further research is needed to elucidate the mechanisms of spore repair and of the unknown repair systems. (JA)

3515 STIMULATION OF NON-CONSERVATIVE DNA SYNTHESIS BY ULTRAVIOLET LIGHT IN FREEZE-TREATED BACILLUS SUBTILIS. Hadden, C. T.; Billen, D.; Corrigan, K. (Univ. of Florida, Gainesville). Biochim. Biophys. Acta; 324: 461-471(1973).

It was shown that ultraviolet irradiation increases the non-conservative incorporation of dTTP into DNA using cells made permeable to ATP and deoxynucleoside triphosphates by freezing. The role of DNA polymerase I in this incorporation was studied using N-ethylmaleimide as a selective inhibitor of DNA polymerases II and III. Ultraviolet stimulation of dTTP incorporation requires ATP and is sensitive to N-ethylmaleimide. However, the inhibitor can no longer block the increase in dTTP incorporation if the cells are incubated for 30 min after irradiation before DNA synthesis is allowed. Since N-ethylmaleimide inhibits excision of pyrimidine dimers from the DNA of irradiated cells, it may be that an early step in dimer excision is required for an increase in dTTP incorporation. Because mutants of Bacillus subtilis lacking DNA polymerase I cannot carry out a high rate of dTTP incorporation when assayed in this manner, and because DNA polymerase I is not sensitive to N-ethylmaleimide while polymerases II and III are sensitive, we conclude that DNA polymerase I very likely catalyzes essentially all of the non-conservative DNA synthesis in both unirradiated and irradiated frozen cells. (auth)

3516 EFFECTS OF HYDROSTATIC PRESSURE AND IONIZING RADIATION ON BACTERIAL SPORES. Wills, P. A. (Australian Atomic Energy Commission, Southerland). At. Energy Aust.; 17: No. 1, 2-10(Jan 1974).

The use of hydrostatic pressure to sensitize bacterial spores to ionizing radiation and heat is described. A possible application for a combination pressure-heat-radiation sterilization process is described. The resistance of bacterial spores to hydrostatic pressure is studied as well as the kinetics of initiation of germination and inactivation. The results imply that the increased inactivation noticed during simultaneous compression and irradiation is not due to synergism, but is simply an additive effect. Combination sterilization techniques using hydrostatic pressure are presented. The results show that the degree of heat or radiation dose required by conventional sterilization techniques can be considerably reduced by using a combination treatment of hydrostatic pressure with heat and/or radiation. (RL)

3517 STERILIZATION BY ELECTRON BEAM IRRADIATION OF TISSUE VALVE AS PROSTHETIC VALVE. Ota, S.; Shiono, T.; Takahashi, T.; Sugiyama, M.; Yokota, A. (Hokkaido Univ., Sapporo). Geka Shinryo; 15: No. 2, 220-226(Feb 1973). (In Japanese).

Human and canine aortic heart valve segments were obtained without using sterilization and sealed intact or inoculated with six species of bacteria and kept frozen until irradiation. They were frozen at a temperature of −78°C after irradiation by linear electron accelerator and were examined by aseptic tests. The strength and elasticity rate of the fresh valve, frozen valve, valve treated with ethanol or formalin or beta-propiolactone (BPL), and the valve frozen after treatment with BPL were measured and compared with each other. Human and canine aortic segments, which were not contaminated with specific bacteria, showed effective sterilization of all samples irradiated with a total dose of more than 2.0 mrad from two directions. Samples contaminated with six species of bacteria showed effective sterilization following irradiation with 3.0 mrad from one direction and with more than 2.0 mrad from two directions. No significant difference was found between the fresh valve, valve irradiated after freezing, valve treated with ethanol or formalin, but the valve treated with BPL and the valve frozen after treatment with BPL showed 20% and 17% decrease of strength respectively in comparison with that of the fresh valve. Elasticity rate of the valve irradiated after freezing showed almost the same value of that of the fresh valve, and the valve treated with ethanol or formalin showed high elasticity value. In comparison with the fresh valve, the valve irradiated with 2.0 mrad from two directions showed a little decrease of nuclear component and a part of it showed a tendency that nucleus becomes dominant. Dissociation and crevice in loose connective tissues and partial separation of endothelial cells were also recognized. But collagenous fiber and elastic fiber were kept well. A tendency of contraction and dissociation in loose connective tissues was also recognized in the frozen valve and valve treated with ethanol or formalin. (JA)

3518 STUDIES OF GENETIC EFFECTS INDUCED IN POPULATIONS BY RADIOACTIVE PRODUCTS OF THE NUCLEAR FISSION OF ^{235}U. I. Mutation Process in Populations Under Prolonged Exposure to Nuclear Fission Products of ^{235}U. Shevchenko, V. A.; Alekseenok, A. Ya.; Prister, B. S.; Ryabov, G. G. (Inst. of General Genetics, Moscow). Genetika; 10: No. 2, 106-114(Feb 1974). (In Russian).

Data are given on dynamics of the mutation process in asynchronous cultures of Chlorella vulgaris Beiyer, LARG-1 strain, under the continuous exposure to radiation from radionuclide mixture imitating fresh (14 hour-old) nuclear fission products of ^{235}U (NFP) and from ^{90}Y introduced into the liquid medium. At the first stage of the experiments the increase in the number of mutant cells and the decrease in the number of viable cells in proportion to the radiation dose were observed in Chlorella cultures that were continuously at the exponential growth phase. Under the decrease of the irradiation dose, the level of viable cells in cultures increased up to the level of the control. Considerable differences in the percentage of mutant cells were observed under the exposure with NFP and ^{90}Y to the end of the experiments. Dynamics of the mutation process in cultures irradiated with ^{90}Y were characterized by the decrease of the mutant percentage in population down to the control level. The number of mutants in the irradiated populations exceeded that of the control under the irradiation of Chlorella cells with NFP mixture at the end of the experiments, when the irradiation intensity caused by long-lived radionuclides retained in the mixture was close to constant. (auth)

3519 MECHANISM OF GENETIC RECOMBINATION DURING CONJUGATION OF BACTERIA. V. Recombination-Induced Heterogeneity of the Progeny of Exconjugantes. Bresler, S. E.; Lantsov, V. A.; Manukyan, L. R. (Leningrad Inst. of Nuclear Physics). Genetika; 10: No. 2, 145-150(Feb 1974). (In Russian).

Effect of recombinogens (moderate uv-irradiation or mitomycin C) on conjugation merozygotes leads to a pronounced increase of the number of heterogenous clones in the progeny. This phenomenon is called induced heterogeneity. The genotypes of clones, appearing as a consequence of induced heterogeneity, are much richer in rare recombination events. The effect of induced heterogeneity is removed by chloramphenicol inhibition of protein synthesis in uv-irradiated exconjugates. It seems improbable that

the mechanisms of general and induced heterogeneity are the same. It is assumed that the latter is caused by the exchange of pieces of single-stranded DNA in merozygotes due to sister-strand exchanges. (auth)

3520 STUDY OF VARIABILITY AND STRAIN SELECTION IN STREPTOMYCES ATROOLIVACEUS. I. UV Light and Nitrous Acid as Effective Agents in the Improvement of Mithramycin Production. Blumauerova, M.; Callieri, D. A. S.; Stajner, K.; Vanek, Z. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague); 19: No. 2, 133-138(1974).

A seven-step selection procedure (repeated uv irradiation, single-step application of nitrous acid, and natural selection, following each mutagenic treatment) made it possible to increase production of mithramycin by Streptomyces atroolivaceus from 40 to 50 μg/ml to 680 to 830 μg/ml, i.e., roughly by 15 to 19-fold. The uv radiation was more effective when applying lower doses, yielding about 5% survival, 2.3% survival was obtained after the treatment with nitrous acid. N-Methyl-N'-nitro-N-nitrosoguanidine applied in a buffer pH 9.0) at doses yielding more than 99% killing was less effective than the two former mutagens. (auth)

3521 EXTENT OF PHENOTYPIC EXPRESSION OF UV-INDUCED STR-R AND STR-D MUTANTS IN ESCHERICHIA COLI B/R THY TRP HCR. Rauko, P.; Slamenova, D. (Cancer Research Inst., Bratislava). Folia Microbiol. (Prague); 19: No. 2, 102-106(1974).

The effect of the preirradiation cultivation during tryptophan and thymine starvation on the extent of phenotypic expression of str-r and str-d mutants of Escherichia coli B/r thy$^-$ trp$^-$ hcr$^+$ was investigated. UV-light was used as a mutagenic factor. The preirradiation cultivation resulting in the inhibition of the total DNA synthesis did not practically influence the frequency of the str-r and str-d mutants. The extent of phenotypic expression was found to increase up to the 2nd hr of cultivation and the maximum phenotypic expression occurred only 4 to 5 hr after the uv irradiation. (auth)

3522 GENETIC INSTABILITY OF UV-SENSITIVE MUTANT OF ACTINOMYCES FLORIDAE NO. 241. Kvasha, V. V.; Preobrazhenskii, L. N.; Matseiyukh, B. P. (Inst. of Microbiology and Virusology, Kiev). Tsitol. Genet.; 7: No. 3, 265-268(1973). (In Russian).

Mutant No. 241 of Act. floridae gives spontaneously a considerable number of morphologically atypical colonies, and is more sensitive to lethal action of uv rays and nitrosoguanidine as compared with initial strain 169. In mutant No. 241, induced mutagenesis is blocked. The system of dark reparation in mutant No. 241 is supposed to be damaged and the state of reparation mechanisms is assumed to be dependent on the cell metabolism, in particular on the process of phloromycin biosynthesis. (auth)

3523 BREEDING OF RHODOTORULA GLUTINIS WITH AN INCREASED SYNTHESIS OF CAROTINE WHEN GROWING ON MEDIA WITH OIL HYDROCARBON. Kvasnikov, E. I.; Sudenko, V. I.; Grinberg, T. A. (Inst. of Microbiology and Virusology, Kiev). Tsitol. Genet.; 7: No. 1, 17-20(1973). (In Russian).

As a result of breeding following mutagenic treatment with ultraviolet rays and ethylenimine, the mutant is obtained synthesizing 550 μg/g of carotine which exceeds carotine synthesis with initial culture almost twice. β-carotine content in mutant amounts to 78% of carotinoid sum. (auth)

3524 RADIATION RESISTANCE OF SPORES OF BACILLUS SUBTILIS AND B. STEAROTHERMOPHILUS AT VARIOUS WATER ACTIVITIES. Haernuly, B. G.; Snygg, B. G. (Svenska Institutet foer Konserveringsforskning, Goteborg). J. Appl. Bacteriol.; 36: No. 4, 677-682(Dec 1973).

The radiation resistance of spores of Bacillus subtilis and B. stearothermophilus was determined under anoxic conditions in water vapor and in aqueous solutions of glucose and glycerol at various water activities. In water vapor, resistance of both kinds of spores increased slightly with decreasing water activity (a_w). In glycerol solutions, a phase of rapid increase in resistance with decreasing a_w was followed by a slower increase on further reduction of a_w. This second phase was almost parallel to the water vapor curve, which, however, showed considerably lower resistance. The initial phase of rapid increase in resistance was also observed in glucose solutions. (auth)

3525 MECHANISM OF RBE EFFECTS IN THE KILLING OF CELLS. Alper, T. (Hammersmith Hospital, London). pp 133-149 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

With higher cells the dependence of RBE on dose (i.e., on level of effect) results from differences in the shapes of dose-effect curves at different LET; extrapolation numbers are often (but not always) lower for survival curves with neutron than with low-LET radiation. Some models set up to account for RBE effects have particularly featured that phenomenon: but such a model would then not have general applicability since, with bacteria, and even with some higher cells, the shapes of survival curves show no change over a wide range of LET; and RBE values are therefore independent of dose. Classical target theory applies well to dry proteins and viruses and, accordingly, RBE decreases with increasing LET for such targets irradiated as individual macromolecules. Thus increases in RBE observed for the killing of both pro- and eukaryotic cells strongly suggest that as ionization density increases there is an increase in the probability of interaction between two sites, each of which has suffered an energy absorption event. Some insight into the nature of these sites has been gained by neutron and x irradiation of strains of microorganisms with differing capacities for repair or bypass of damage to nucleic acid. Investigations of a different nature had called for a model accounting for cell killing by ionizing radiations in terms of lesions in membranes as well as in DNA, and this model accommodates also the differences in RBE for microorganisms with different repair capacities. While energy deposition events in DNA and membrane may independently kill cells, there is evidence of interaction between such events. The probability of interaction of lesions in DNA and membranes is conceptually increased by recent studies demonstrating that DNA is intimately attached to the plasma membrane in bacteria, and to the nuclear membrane in higher cells and that the points of attachment are also the origin of DNA synthesis. It has been pointed out that if RBE effects are to be accounted for by interaction of lesions engendered by single energy deposition events, reduction in oxygen enhancement ratio with increase in LET must be accounted for in terms of the oxygen in the track hypothesis. This hypothesis is supported by experiments on Chlamydomonas as well as bacteria. (auth)

3526 DIFFERENT EFFECTS OF ELECTRONS AND NEUTRONS ON CELL KILLING AND ABILITY OF DNA-MEMBRANE COMPLEX TO SYNTHESIZE DNA IN E. COLI B/r AND Bs-1. Cramp, W. A.; Bryant, P. E. (Hammersmith Hospital, London). pp 165-175 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The effect of rifampicin after irradiation on cell killing and ability of a DNA-membrane complex to synthesize DNA has been studied in strains E. coli B/r and Bs-1. For cell killing as a test of damage rifampicin had a much greater enhancing effect after irradiation of E. coli B/r in anoxic conditions than in aerobic conditions, which indicates that this drug inhibits repair of type N damage. Rifampicin enhanced the effect of neutrons on DNA synthetic activity of DNA-membrane complex extracted from irradiated E. coli B/r but did not enhance the effect of neutrons on E. coli Bs-1. It is suggested that a type N site resides in the DNA-membrane complex and consists of RNA, possibly structural in function. The effect of damage to this RNA element is manifest with regard to DNA synthetic activity of DNA-membrane complex only when the site of damage is close to a site of type O damage, i.e., after irradiation with radiation of high LET. We suggest that the structural positions of type N and type O sites are different in the strains E. coli B/r and Bs-1. (auth)

3527 RECOVERY AND REPAIR IN YEAST CELLS AFTER IRRADIATION WITH DENSELY IONIZING PARTICLES. Pohlit, W. E.; Schaefer, M. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). pp 177-184 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

A cybernetic model was developed for radiation effects in living cells. This model includes quantitative changes in radiation sensitivity with absorbed dose, recovery (split-dose reactivation), and repair (liquid-holding reactivation). The model was tested extensively with sparsely ionizing radiations (x rays and electrons) using diploid and haploid yeast cells. Experiments are described in which the model was used for analyzing irradiation with α particles from an Am source. These particles are representative for densely ionizing particles with known LET distribution of absorbed dose. It can be shown quantitatively how much the irreparable fraction of the radiation damage is increased in comparison with sparsely ionizing radiations. The quantitative data can be used to predict reactions of fast and slow neutrons of various energy distributions. The consequence of these results for radiation

therapy with fast neutrons and for radiation protection is discussed. (auth)

3528 RBE OF THE $^{10}B(n,\alpha)^{7}Li$ CAPTURE REACTION OF THERMAL NEUTRONS INSIDE THE GREEN ALGA CHLORELLA PYRENOIDOSA. Knoop, H. U.; Paschke, M. (Kernforschungsanlage, Juelich, Ger.). pp 215-219 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Unicellular green algae Chlorella pyrenoidosa were grown in nutrient solutions containing 100 mg/liter of $H_3{}^{10}BO_3$ and $H_3{}^{11}BO_3$ respectively, and then irradiated in the thermal column of the 10 MW swimming-pool reactor FRJ-1 MERLIN. The measured difference in the colony-forming ability of the cells and the uptake of sodium after irradiation is due to the $^{10}B(n,\alpha)^{7}Li$ capture reaction of thermal neutrons. The ^{10}B reaction reveals a high dose-related effectiveness in damaging the colony-forming ability of the cells. The slope of the nearly exponential dose effect curve is 721×10^{-6}/rad, compared to 598×10^{-6}/rad for the $^{14}N(n,p)^{14}C$ reaction, 230×10^{-6}/rad for fission neutrons, and 118×10^{-6} for x rays. However no effect can be measured on the uptake of ^{24}Na ions by the ^{10}B reaction, while all other reactor radiations together damage very effectively. The results are briefly discussed. (auth)

Radiation Effects on Plants

Refer also to abstracts 2737, 3505, 3508, 3668, 4118, 5219, and 5485.

3529 (CONF-720486-, pp 15-18) EFFECTS OF GAMMA RADIATION ON THE CAROTENE CONTENT OF MANGOES, VARIETIES PICO AND CARABAO. Manalo, J. A.; Cardeno, V. (Philippine Women's Univ., Manila). 1972.

From joint annual convention of the radioisotope and nuclear medicine meeting; Quezon City, Philippines (7 Apr 1972).

Preliminary studies on extension of shelf life by irradiation of the two varieties of mango have shown promising results. The highly prized fruits are eaten not only because of their sweet taste but because they are good sources of vitamin A. It would be undesirable therefore if a significant amount of this vitamin or its precursor were destroyed by ionizing radiations. This investigation thus attempts to determine the effects of varying doses of gamma radiation on the carotene content of two varieties of mangoes, qualitatively and quantitatively. (auth)

3530 (STI/PUB-352) BIOLOGICAL EFFECTS OF NEUTRON IRRADIATION. Proceedings Series. Proceedings of the symposium on the effects of neutron irradiation upon cell function held in Nuremberg, Germany, October 22-26, 1973. (International Atomic Energy Agency, Vienna (Austria)). Feb 1974. 492p. (In French and English). (CONF-731038-). IAEA $22.00.

Separate abstracts were prepared for 31 papers presented at this symposium. Abstracts of four papers appeared in NSA previously as 29: 05307, 05308, 05341, and 10330. (CH)

For abstracts of individual papers see: 3499-3506, 3525-3528, 3549-3552, 3622, 3663-3671, 4118, 5219, 5220, 5485, and 5486.

3531 (STI/PUB-359) POLYPLOIDY AND INDUCED MUTATIONS IN PLANT BREEDING. Panel Proceedings Series. Proceedings of a Meeting Held in Bari, Italy, October 2-10, 1972. (International Atomic Energy Agency, Vienna (Austria)). Mar 1974. 420p. (In French and English). (CONF-721034-). IAEA $18.00.

Separate abstracts were prepared for 15 of the 48 papers included. Thirty-three papers discuss various aspects of mutation breeding programs employing chemical mutagens. (ERB)

For abstracts of individual papers see: 3553-3567.

3532 NUCLEOLI IN X-IRRADIATED MERISTEMS. Clowes, F. A. L.; De La Torre, C. (Oxford Univ.). Cytobiologie; 6: No. 3, 318-326(Nov 1972).

Primary roots of Zea mays seedlings were irradiated with 1,700 rads from a generator operating at 100 kV peak. The root tips were fixed at 1 and 2 hrs after irradiation, stained and prepared for histological examination. The x irradiation causes an alteration of the relationship between the nucleolar and chromosomal cycles in different parts of the root meristem. It also induces segregation of the granular and fibrillar components of nucleoli, fuses the nucleolar vacuoles and causes other nucleolar abnormalities. (GE)

3533 STEM GROWTH, NUMBER OF LEAVES AND BRANCHES DEPENDING ON GAMMA-IRRADIATION AND POST-IRRADIATION PRE-SOWING TEMPERATURE TREATMENT OF CUCURBITA MAXIMA DUCH. Goranov, A. God. Sofii, Univ., Biol. Fak.; 65: No. 2, 149-171(1972). (In Bulgarian).

Air-dried seeds of Cucurbita maxima (squash) 48/4 were used. They were irradiated with 4,000 and 50,000 R. Temperature treatment was applied for 30 min at +80°C and +90°C. Field experiments were carried out in 1968, 1969, and 1970. It was established that the presowing temperature treatment and raising the temperature show a tendency to inhibit the stem growth, the number of leaves and branches. The irradiation dose 4,000 R stimulates the stem growth, the number of leaves and branches, while at rates of 50,000 R they are inhibited. The postirradiation presowing temperature treatment shows a tendency (by increasing of t° to 90°) to eliminate the stimulation effect on the stem growth, the number of leaves and branches at 4,000 R and the inhibition effect at 50,000 R. (auth)

3534 VIABILITY AND GERMINATION OF COTTON POLLENS AFTER GAMMA IRRADIATION. Bakhromov, K. B.; Kandov, A. I.; Yaminov, T. I. (Inst. of Experimental Biology of Plants, Tashkent). Uzb. Biol. Zh.; No. 2, 62-63(1973). (In Russian).

Data are presented on the viability and germination of gamma-irradiated (^{60}Co) cotton pollens. Presowing irradiation of frozen seeds with doses of 1, 1.5, and 2 kR affected different parts of the generative cycle, with, in particular, a decrease in the viability and growth of the pollens. (tr-auth)

3535 METAPHASE METHOD FOR ANALYSIS OF CHROMOSOME REARRANGEMENTS IN BARLEY. Gilyarovskaya, T. T. (Inst. of General Genetics, Moscow). Tsitol. Genet.; 7: No. 4, 369-370(1973). (In Russian).

A technically simplified method is described for making total preparations for a metaphase analysis of structural chromosome rearrangements in the barley root meristem. After treating dry barley seeds with γ rays in a dose of 10 kR, the rearrangements mainly of chromosomal type were found. The investigation carried out confirms that most cells of the barley root meristem are at the presynthetic stage (G_1). (auth)

3536 EFFECT OF IONIZING RADIATION ON BARLEY FERTILITY AND FREQUENCY OF CHROMOSOME ABERRATIONS IN MEIOSIS. Dishler, V. Ya.; Filipeka, V. F.; Nagle, E. F. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 7, 42-46 (1973). (In Russian).

Air-dried seeds of Maya spring barley variety were irradiated with fast neutrons (0.05 to 0.8 krad) or gamma rays (0.5 to 8.0 kR) to determine which form of irradiation produces the largest number of chromosome translocations. Increasing the dose of fast neutrons produced a linear increase in the number of M_1 plants with semisterile central heads and sterile flowers, whereas sterility was not affected significantly by increasing the dose of gamma rays. Plants with completely sterile heads were found when the seeds were irradiated with fast neutrons at 0.2 krad or more or gamma rays at 2 kR or more. The frequency of cytogenetic injuries in meiotic cells after irradiation was 9.1 to 19.9% in prophase-metaphase I and 0.2 to 2.9% in anaphase I. The frequency of injury was independent of the kind and dose of radiation used. Fast neutrons at 0.1 to 0.4 krad and gamma rays at 8.0 kR induced the largest number of major chromosome translocations. (JPRS)

3537 INFLUENCE OF GAMMA RADIATION ON THE PHOTOSYNTHESIS ACTIVITY OF BARLEY SEEDLINGS. I. Assimilation of $^{14}CO_2$ by Leaves. Fernandez, J.; Sanz, M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 86, 437-445 (1973). (In Spanish).

The variation of the photosynthesis activity of barley plants irradiated two weeks after sprouting with doses of 1, 10, 50, 100, 200, 300, 400, and 500 kRad at a flux of 56.7 rad/sec was studied. The determination of the photosynthesis activity was done weekly during the months following the irradiation in a climatically sealed chamber specially designed to study photosynthesis with $^{14}CO_2$. The quantity of carbon assimilated is determined by counting in a liquid scintillator samples taken from the leaves exposed to $^{14}CO_2$. In the plants receiving 1 kRad a gradual increase in the rate of assimilation is observed. Doses higher than 100 kRad inhibit photosynthesis and translocation of the photoassimilated products. At intermediate doses a gradual decrease of the assimilation is obse-ved. (tr-auth)

3538 EFFECT OF ETHYLENIMINE AND IRRADIATION BY ^{60}Co ON THE GROWTH, YIELD, AND CAPSAICINE CONTENT OF PEPPER (CAPSICUM ANNUUM L.). I. Zderkiewicz, T. (Coll. of Agriculture, Lublin). Acta Agrobot.; 24: 343-356(1971). (In Polish).

Application of mutagenic factors (EI in concentrations: 0.03%, 0.06%, 0.125%, 0.25%, and doses of ^{60}Co rays: 5,000, 10,000, 15,000, and 20,000 R) were used. Ethylenimine and irradiation had a positive effect on the capsaicine content in fruits of pepper.

Difference in the growth of plant and size and weight of fruits were observed. (auth)

3539 ASCORBIC ACID CONTENT IN DIFFERENT STAGES OF RIPENING PEPPER FRUITS UNDER THE ACTION OF ETHYLENIMINE AND IRRADIATION BY USING ^{60}Co. Zderkiewicz, T.; Dyduch, J. (Coll. of Agriculture, Lublin). Acta Agrobot.; 25: 171-178(1972). (In Polish).

Investigations on the ascorbic acid content during subsequent stages of ripeness pepper fruits submitted to the influence of EI and irradiation by ^{60}Co. Considerable variation was found in the ascorbic acid content in the pepper fruit, depending on the ripeness stage, the EI concentration and the dose of ^{60}Co. The highest content of this compound was found at the intermediate ripeness stage, the lowest, at the technical ripeness stage. EI caused vitamin C increase at the concentration of 0.03% and 0.125%, and ^{60}Co—at the 5,000 R dose. (auth)

3540 ROLE OF AUXINS IN THE REVERSAL OF RADIATION-INDUCED GROWTH INHIBITION IN PLANTS. Anantha-swamy, H. N.; Ussuf, K. K.; Nair, P. M.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). Radiat. Res. Rev.; 3: No. 4, 429-445(Jul 1972).

From symposium on the recent advances in the chemistry of food irradiation; Los Angeles, CA (1 Apr 1971).

A study was made of the effect of low doses of gamma radiation on auxin metabolism in plant systems and the reflection of this in vital metabolic processes controlled by gibberellic acid or indole acetic acid. (LK)

3541 MULTIPLE-CLUSTER MUTATION COMPLEX IN MUTAGENESIS WITH HIGHER PLANTS. Snarma, B.; Bansal, H. C. (Indian Agriculture Research Inst., Delhi). Theor. Appl. Genet.; 42: No. 1, 25-31(1972).

After treatment of dry and pre-soaked seeds of barley with gamma rays, EMS, NEU and EI, the frequency of multiple mutations (multimutations) was higher with EMS and NEU-treatment, while cluster mutations appeared in greater numbers following treatment with gamma rays and NEU. Pre-soaking the seeds led to a reduction in the frequency of total-mutations, cluster mutations and multimutations. This was a result of the application of lower doses and induction of mutations at a relatively later stage in ontogenetic development in the case of pre-soaked seeds. The mutation frequency of different seedling mutation types, when taken separately was independent of the mutagen employed and the stage of treatment. The size of mutated chimeras in M_1 plants, as indicated by the segregation ratio of mutants in M_2, was largest in albina, xantha, chlorina, albina-tigrina, chl-terminalis and ecriferum, and lowest in viridis, viridoalbina etc. This could be expected if the unstable permutations induced by mutagenic treatment are resolved into mutations at different intervals after their initiation, or it can be explained by the induction of dominant mutations, or lethal changes together with visible mutations. (Indian Sci. Abstr.)

3542 GERMINATION ENERGY AND THE GERMINATION OF SEED AND GROWTH OF THE MAIN ROOT AND HYPOCOTYLS, AS AFFECTED BY GAMMA-IRRADIATION AND POSTIRRADIATION TEMPERATURE TREATMENT OF CUCURBITA MAXIMA DUCH. Goranov, A. God. Sofii. Univ., Biol. Fak.; 65: No. 2, 123-148(1972). (In Bulgarian).

The irradiated air-dried seeds of Cucurbita maxima Duch. cultivar Edra byala 48/4 with 4000 and 50,000 R gamma rays (dose rate of 630 R/min) were exposed to postirradiation temperature treatment at 80 and 90°C for a period of 30 min. It was established that the γ-irradiation and the temperature treatment, applied separately, suppress the germination energy and seed germination. The postirradiation temperature treatment eliminated to a certain extent the suppressing of germination. The irradiation dose of 4000 R induced stimulation of the growth of the main root and hypocotyls, while 50,000 R induced inhibition. The presowing temperature treatment at 80°C for 30 min stimulated the growth of the main root and hypocotyls, while 90°C for 30 min produced inhibition. The postirradiation presowing treatment eliminated the stimulation effect on the growth of the main root and the hypocotyls for 400 R and showed a tendency of eliminating the effect of suppression, characteristic for 50,000 R. (auth)

3543 INFLUENCE OF PRESOWING GAMMA-IRRADIATION ON THE YIELD OF PHASEOLUS VULGARIS VAR. SUBCOMPRESSUS ALL. Goranov, A.; Angelov, A. God. Sofii. Univ., Biol. Fak.; 65: No. 2, 186-206(1972). (In Bulgarian).

Air-dried elite seeds of Phaseolus vulgaris var. subcompressus All., variety 1026, were irradiated at rates of 125, 250, 500, 1000, 2000, 4000, 8000, and 16,000 R with dose rates of 630 and 504 R per min. The presowing effect of γ-irradiation on the field germination, weight of plant, pod number per plant, seed number per pod, seed number and seed weight per plant, and bean seed yield per decare, were investigated. It was established that with increasing dose of treatment, seed germination is delayed, the plant mass blossom and seed ripening are prolonged by 7 to 10 days, and field germination is decreased. Weight per plant, pod number per plant, seed number per pod, seed number per plant and seed weight per plant, decreased too. Regardless of the meteorological conditions the seed yield of bean decrease with increasing the irradiation dose. The differences are considerable at rates of 2000 R, and increase further under treatment with 4000 and 8000 R. Significant stimulation of the structural elements of the seed yield per decare has not been established. (auth)

3544 RADIOSENSITIVITY AND MUTABILITY IN ALFALFA. I. Radiosensitivity in Alfalfa as Influenced by the Gamma-Irradiation Dose. Topchieva, A.; Georgiev, Z. Genet. Selek.; 5: No. 6, 473-481(1972). (In Bulgarian).

The study was designed to test the influence of the irradiation dose of gamma rays on the radiosensitivity of six alfalfa varieties: Pleven 1, Du Puits, Ranger, Vernal, and Neugaterslebener belonging to Medicago sativa L., and Kubanskaya Zheltaya belonging to Medicago falcata L. All varieties differ in their sensitivity to gamma rays. The critical dose (LD_{50}, after Gustavsson, 1957) for Neugaterslebener was about 50 krad; that for Ranger, Vernal and Du Puits was about 80 krad, and for Pleven 1, between 80 and 100 krad. The critical dose for Kubanskaya Zheltaya (M. falcata) was beyond the highest irradiation dose (100 krad). A consistent negative correlation between the frequency of chromosome aberrations and the field germination ability, survival rate and seed formation was found to exist within the individual varieties. The gamma rays do not exert any essential influence on the frequency of self-incompatible forms which are useful for breeding. The irradiation doses of 50 and 100 krad increase the chromosome aberration frequency of the male-sterile plants of Pleven 1. (auth)

3545 REMOVAL OF DAMAGING EFFECT OF HIGH DOSES OF γ RADIATION IN COTTON SEEDS TREATED WITH THERMAL FACTOR. Kuliev, A. M.; Shirinov, I. G.; Kononenko, A. V. (Inst. of Genetics and Breeding, Baku). Tsitol. Genet.; 7: No. 1, 46-50(1973). (In Russian).

It was established that in cotton seeds treated with high doses of γ rays (30, 40 and 50 krad) the damaging effects of radiation can be removed by means of their subsequent treatment with high (60 to 70°C) and low (−78°) temperature during 24 and 6 to 12 hrs respectively. Therewith among the survived plants various mutation changes are observed. (auth)

3546 THEORY OF RADIOBIOLOGICAL EFFECT OF INTENSIVE ^{60}Co γ RADIATION IN HELIANTHUS ANNUUS L. Kovachik, A. Tsitol. Genet.; 7: No. 1, 25-32(1973). (In Russian).

Effect of intensive irradiation of Helianthus annus L. achenes with ^{60}Co γ rays on an increase in the content of organic phosphorus compounds, except for phosphorus of nucleic acids, depends on the duration of irradiated seed storage. A decrease in nucleic acid content with a dose and under the effect of storage of irradiated achenes during a week testifies to a considerable damage in the genetic apparatus of the nucleus. The data obtained make the ideas of radiobiological effect of irradiation more profound, especially from the view of biochemical interpretation of cellular and plant metabolism. (auth)

3547 CYTOGENETIC EFFECT OF COMBINED ACTION OF γ RAYS AND NITROGEN MUSTARD ON CELLS OF CREPIS CAPILLARIS AT THE STAGE OF PRESYNTHESIS. Baburina, N. D. (Inst. of Genetics and Breeding of Industrial Microorganism, Moscow). Tsitol. Genet.; 7: No. 3, 277-279(1973). (In Russian).

Chromosome aberration frequency induced by combined treatment was considerably higher than frequency of aberrations induced by γ rays and nitrogen mustard separately. These results are considered from the view-point of reparation enzymes' participation in the mutant process. (auth)

3548 EFFECT OF γ IRRADIATION ON MUTABILITY FREQUENCY OF COTTON VARIETIES AT VARIOUS STAGES OF ITS DEVELOPMENT. Kuliev, A. M.; Mamedova, M. Z. Tsitol. Genet.; 7: No. 5, 408-412(1973). (In Russian).

To increase the frequency of variability and mutability of cotton species Gosypium hirsutum L., the most effective method is irradiating the growing plants with ^{60}Co γ rays at the bud stage (2 kR) and partially during fluorescence (3 kR). In the first case the variability ranges from 66.6 to 84.5% (7.6 to 16.6 for economically valuable species); in the second one—50.0 to 74.0 (2.9 to 10.0, respectively). At both stages of irradiation percentage of mutability in M_4 is equalized. (auth)

3549 USE OF A CYCLOTRON AS A FAST NEUTRON SOURCE IN PLANT BREEDING AND GENETICS. Huczkowski, J.; Gacek, E.; Wojciechowski, H. (Inst. of Nuclear Physics, Krakow). pp 49-57 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The use of the U-120 Cracow cyclotron for neutron irradiation of seeds by fast neutrons with the $^{9}Be(d,n)^{10}B$ nuclear reaction is described. Preliminary results of the neutron irradiation of microorganisms are also included. The neutron flux was controlled on the basis of ion current measurements and by activation methods. The neutron dose was controlled by biological monitors. Ionization chambers were used for the absolute measurement of neutron doses and doses of gamma contamination. The effects of irradiation of seeds were studied throughout the vegetation period of N_1 plants for optimum dose determination. The chromosomal aberrations were observed. A comparison of the U-120 cyclotron and nuclear reactors as neutron sources for plant breeding is made. (auth)

3550 EFFECTIVENESS OF FISSION NEUTRONS, 14.7-MeV MONOENERGETIC NEUTRONS, AND ^{60}Co GAMMA RADIATION ON SEEDLING GROWTH REDUCTION AND INDUCTION OF CHLOROPHYLL-DEFICIENT MUTATIONS IN BARLEY. Conger, B. V.; Constantin, M. J. (Univ. of Tennessee, Knoxville). Contract AT(40-1)-GEN-242. pp 417-432 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Results are reported from experiments with seeds (caryopses) of two barley cultivars (Hordeum vulgare L. emend. Lam. cv. Himalaya and Atlas-57). Growth of Himalaya seedlings from seeds of 2 to 13% water content irradiated in vacuo and soaked in nitrogen-bubbled water at 0°C indicated fission neutrons (N_f) to be 54 to 60 times more effective than ^{60}Co γ radiation. When seeds were irradiated similarly but soaked in oxygen-bubbled water at 0°C the RBE of N_f ranged from 7.6 at 2.2% to 60 at 13.0% water content. At 32% water seeds became more radiosensitive but proportionately more so to γ radiation, therefore the RBE of N_f decreased to 7.5. Germinated seeds (24 h) were slightly more radiosensitive than dormant seeds of 32% water content and the RBE of N_f was 6.8. The change in RBE of N_f with changing seed water content and/or oxygen availability is caused by the greater effect of these factors on the modification of γ-radiation-induced damage. The results are discussed in terms of direct versus indirect mechanisms of radiation action. In seeds of 13% water 14.7-MeV neutrons were slightly less effective than N_f in reducing seedling growth of both Atlas-57 and Himalaya. Both neutrons were 50 to 60 times more effective than γ radiation. The Atlas-57 cultivar was more sensitive to all three radiations than Himalaya. For the chlorophyll-deficient mutation studies seeds of Atlas-57 were adjusted to a water content of 13% and irradiated with varying doses of ^{60}Co γ radiation, N_f, and 14.7-MeV neutrons. Mutagenic effectiveness of N_f was higher than 14.7-MeV neutrons but both neutrons were much more effective than γ radiation. The RBE's for mutations per 1000 M_2 seedlings per rad $\times 10^{-2}$ were 73.2 and 132.2 for 14.7-MeV neutrons and N_f, respectively, compared to γ radiation. Mutagenic effectiveness calculated on an M_2 seedling basis was independent of dose for all radiations. Mutagenic efficiency computed on the basis of the frequency of mutations per 1000 M_2 seedlings versus percentage reduction in M_2 seedlings per spike showed that ^{60}Co γ rays may be more efficient than either of the two types of neutrons. (auth)

3551 RADIOSENSITIVITY OF PLANT SEEDS TO NEUTRONS AND ITS MODIFICATION. Gopal-Ayengar, A. R.; Rao, N. S.; Singh, B. B. (Bhabha Atomic Research Centre, Trombay, India). pp 433-439 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Seeds of 12 crop plants were found to differ in their response to fast neutrons and γ rays. Depending on the radiosensitivities of seeds, the RBE values calculated from doses for 50% reduction in seedling height varied from 6.7 to 36.0. In general, the RBE of fast neutrons was higher for sensitive seeds than for resistant ones, which has been ascribed to their capacity to repair radiation damage. The RBE values were also found to depend on such criteria of damage as seedling height, chromosome aberration, seed sterility, and mutations. The radiosensitivity of barley seeds (13% moisture) to fast neutrons was also found to increase on storage for 10 days after irradiation. Seeds exposed to γ rays, however, showed no storage effects under similar conditions. On the other hand, the frequency of chlorophyll mutations and chromosome aberrations decreased on storage after irradiation of rice and barley seeds with thermal neutrons. This was attributed to the radiations from neutron-induced radionuclides in seeds. Such radiations were also found to reverse the toxicity of diethyl sulphate to rice seeds. (auth)

3552 COMPARISON OF THE PHYSIOLOGICAL AND GENETIC EFFECTS OF NEUTRON AND GAMMA RADIATION ON CARNATION (DIANTHUS CARYOPHYLLUS L.) PIPINGS. Pereau-Leroy, P. (CEN de Cadarache, Saint-Paul-lez-Durance, France). pp 441-449 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974). (In French).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Most research into the use of neutrons to improve plants by mutagenesis has consisted in treating the seeds of sexually reproducing plants. It has been shown that neutrons offer various advantages over γ rays: the results are influenced less by the physiological condition of the seeds; the mutagenic effectiveness is greater; and there is sometimes a degree of mutagenic specificity. A comparison was made between the effects of fission neutrons and ^{60}Co γ rays on carnation pipings before they had formed roots. The variety used (Jacqueline) is a periclinal chimera of known histogenetic structure derived from the highly heterozygous William Sim variety. Effects of the two types of radiation on the speed with which the pipings took root, their survival, modifications in the chimera structure caused by radiation-induced meristematic lesions, and the frequency and spectrum of the induced morphological mutations were determined. For a given equal survival rate, the pipings took root more slowly after γ irradiation; beyond 5000 rads in the case of γ rays and 1200 rads in the case of neutrons the pipings were for all practical purposes no longer able to form roots. On the other hand, pipings that had taken root showed a higher survival rate after γ irradiation, in other words, the biological effectiveness of the neutrons was greater at the meristematic cell level. Whichever kind of radiation was used, the total dechimerization frequency passed through a maximum and then declined with increasing dose. This is due to the destruction of the terminal and sub-terminal meristems by the higher doses, which shows clearly the lower radiation sensitivity of the axillary meristems at rest during irradiation. In relation to the survival rate, the mutation frequencies obtained with the two kinds of radiation were not appreciably different; the same applies to the spectra of the mutants judged solely on the basis of their phenotype. (auth)

3553 MUTATION YIELDS AND TYPES OBTAINED IN PEANUTS, A. HYPOGAEA, BY TREATING MATURE SEEDS WITH ETHYL METHANE SULFONATE AND GAMMA RAYS, AND DEVELOPING EMBRYOS WITH ETHYL METHANE SULFONATE. Ashri, A.; Levy, A. (Hebrew Univ., Rehovoth, Israel). pp 1-12 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Mature seeds of three peanut varieties were treated with 14 or 26 krad of gamma rays or 0.4% solution of ethylmethane sulphonate (EMS) (24 h). In a fourth variety, EMS treatments of 0.4 and 0.6% (24 h) of developing embryos (DE) were compared with 0.4% (24 h) treatments of mature seeds (MS). In the first part, gamma-rays gave a higher mutation rate than EMS. In the 26-krad treatment, M_1 germination was lower but the M_2 mutation frequency was higher. In the erect Congo and Dixie Anak, reduced plant size mutations were most common, followed by chlorophyll mutations, while growth-habit mutations were much less frequent. In the trailing TBR (V4) all three MS treatments produced a high frequency of erect mutations. The highest rates were obtained with gamma rays. In the second part, the DE treatments with EMS in variety S9 gave more than twice the mutation rate of the MS treatments. In the DE treatments chlorophyll and reduced plant size mutations were nearly equal in frequency, constituting about 85% of all mutations. In the MS treatments the chlorophyll mutations were somewhat more frequent and both made 94% of the total mutations. Mutations affecting leaflets, which were five times more common in the DE treatments, accounted for most of the differences. There were differences between the DE and MS treatments also in the frequencies of albino, virescent, and xantha mutants. Chimera size in the DE treatments was markedly larger. (auth)

3554 RADIATION-INDUCED MALE STERILITY IN DURUM WHEAT. Bozzini, A. (Centro Studi Nucleari Della Casaccia, Rome). pp 23-25 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

It is only recently that genic male sterile mutations have been discovered both in bread and durum wheat. In most cases male sterility seems to be simply inherited. A spontaneous male sterile mutant has been previously described in a segregating family of a cross between Yuma and Cappelli. After mutagenic treatment (fast neutrons) of seeds of cv. Russello, a M_2 family segregating for male sterility has been isolated. In a series of crosses and segregation studies the mutation appears to be controlled by a single recessive factor. This factor seems to be different from the one previously studied. The isolation of gene-controlled male sterility has been used in a breeding program aiming at the production of spontaneous crosses in populations of durum wheat grown in bulk for several generations. Other possible applications of genic male sterility to breeding problems are discussed. (auth)

3555 PRODUCTION OF POLYPLOIDS BY THE ADVENTITIOUS BUD TECHNIQUE. Broertjes, C. (EURATOM-ITAL, Wageningen, Netherlands). pp 29-34 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

It has been demonstrated in various plant species that a high percentage of solid, non-chimeral mutants is obtained after the irradiation of freshly detached leaves and the subsequent development of adventitious buds and plantlets. Colchicine-treated leaves of Achimenes, Saintpaulia, Streptocarpus, and other species produce a high percentage of non-cytochimeral polyploids among the adventitious plantlets formed. By selection among the autotetraploids as well as by combined treatments with colchicine and irradiation a few promising Streptocarpus mutants have been obtained. (auth)

3556 RADIATION BREEDING OF WARM SEASON FORAGE AND TURF GRASSES. Burton, G. W. (Univ. of Georgia, Tifton). pp 35-39 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Radiation breeding at the Georgia Coastal Plain Experiment Station has involved Paspalum dilatatum var. paucicilatum Parodi; P. notatum Flugge; Pennisetum typhoides (Burm.) Stapf and C. E. Hubb; Cynodon dactylon (L.) Pers.; and C. dactylon × C. transvaalensis Burtt-Davy hybrids. Exposing seeds of prostrate dallisgrass, Paspalum dilatatum, to 20 hours of thermal neutrons quadrupled mutation frequency, created mutants that "bred true" (by apomixis), did not break apomixis, and did not increase ergot resistance nor yields of seed or forage. Recurrent exposure of pearl millet, Pennisetum typhoides, seed to thermal neutrons did not increase forage yields but did supply simply inherited early-maturing, dwarf, male-sterile and chlorophyll-deficient mutants. Mutants resistant to downy mildew, Sclerospora graminicola, were isolated. Lines carrying translocations and inversions were produced. Several thousand dormant short rhizome sections of the sterile "Tifgreen", "Tifdwarf", and "Tifway" turf bermudagrass, Cynodon dactylon, varieties were exposed to 5000 to 12,000 R. A total of 158 interesting mutations, some showing economic potential, were isolated. Some 400,000 baled green stems of the sterile pasture bermudagrass hybrid, "Coastcross-1", exposed to 7 kR at Oak Ridge and planted at Blairsville, Ga., 21 June 1972 developed 25 chlorophyll-deficient stem sectors and gave rise to four plants that survived the winter. Plants from non-irradiated stems were winter-killed. (auth)

3557 CHLOROPHYLL-DEFICIENT MUTANTS IN BARLEY: EFFECTS OF CHEMICAL MUTAGENS ON IRRADIATED AND NON-IRRADIATED SEEDS AFTER VARIOUS PERIODS OF PRESOAKING. Constantin, M. J.; Conger, B. V.; Chowdhury, J. B.; Ramage, R. T. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. pp 53-62 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Data are presented from two experiments with seed of Hordeum vulgare L. emend Lam. cv. "Atlas 57". The objective of this research was to determine whether the treatment of irradiated and non-irradiated seed with 5-bromouracil (BU) and ethylmethane sulphonate (EMS) after various periods of presoaking would increase the frequency and/or alter the spectrum of chlorophyll-deficient mutants. In experiment I, seeds were adjusted to a water content of 13% and sealed in glass tubes. Non-irradiated and irradiated (either 15 krad gamma rays or 490 rad fission neutrons) seeds were subdivided and treated with either BU (0.04M) or EMS (0.03M) following 0.8 and 16 h presoaking. The chemical solutions were buffered at pH 7.5 and seeds were treated for 6 h at 21 to 23°C followed by a 4-h rinse in running tap-water. Similar procedures were used for experiment II, except that BU was not used, gamma-ray doses were 20, 25, and 30 krad, fission-neutron doses were 370, 450, and 525 rad, and seeds were presoaked 16 h only prior to treatment with EMS (0.03M). Results of both experiments are summarized together. M_1 plants survival was reduced by less than 25%. Sterility, expressed as M_2 seedlings per spike, ranged from 8 (neutrons plus EMS) to 106% of control (BU). The degree of sterility following seed treatment with EMS increased as duration of presoaking was increased from 0 to 16 h. Combined radiation and EMS treatments were most damaging in this respect. Chlorophyll-deficient mutant frequency, expressed as mutation events per 100 M_1 spikes, was unaffected by BU alone and lower for radiation plus BU than radiation alone. The frequency ranged from 3 to 6 for gamma rays alone, from 15 to 21 for gamma rays plus EMS, from 7 to 9 for fission neutrons alone, and from 8 to 14 for fission neutrons plus EMS. In both experiments, the rank order of treatments was gamma rays + EMS > EMS > neutrons + EMS > neutrons > gamma rays. Although indications of preferential recovery of chlorophyll mutant types were observed, there was no clear-cut demonstration of superiority by one or more seed treatments. In general, the order of frequency for the different mutant types was albina > viridis > xantha > tigrina > striata. Considerable variation was observed among treatments for the ratio of albina to viridis mutants. (auth)

3558 SOMATIC VARIATIONS ON TWO GENIC CHLOROPHYLL MUTANTS OF NICOTIANA TABACUM L., THEIR GENETIC NATURE, AND THE FACTORS FAVORING THEM. Deshayes, A.; Dulieu, H. (INRA, Dijon, France). pp 85-99 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974). (In French).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Two mendelian mutants of Nicotiana tabacum L. were isolated by mutations after EMS treatment of seeds. The first mutant was called $a_1^T/a_1a_1^T/a_1$, and the second TL/tl, T and L standing for temperature and light sensitivity. Because, in both mutants, the heterozygous genotypes have a light-green color (semidominant action of the mutated alleles), the homozygous being light-yellow, it is easy to detect somatic variations in the palissade cells. Three phenotypes appear as abrupt variant clusters of cells on the leaves, at various frequencies: (a) greener, (b) yellower tissues than the surrounding, in isolated areas, and (c) between areas of greener and yellower tissues. Variations have been observed, (1) on the heterozygous plants for a_1 or tl gene; (2) on the homozygous plants for a_1 or for tl mutated gene; and (3) on the haploid carriers of tl. Variant mesophyll explants were cultured in vitro on Murashige & Skoog medium, with kinetin and IAA. The regenerated variant shoots corresponding to the variant differentiated palissade cells were collected. Such a method allowed the genetic tests for genotype modifications. Several genotypic changes have been detected. Among the simple events (non-reciprocal variations) are: (1) The transition of the marker locus from heterozygous to homozygous state; (2) The deletion, giving hemizygous genotypes for a_1^T or a_1, and more rarely the duplication of an allele; (3) The presence of an other gene, in heterozygous state, which suppresses the marker gene, or which functions additively with the marker gene; (4) The modification of the mutated sites forming intermediate alleles between the initial mutated allele and the wild allele. Among the twin-events (reciprocal variations) were: (1) Exchanges between two homologous loci with or without deletion of one exchanged chromatid part; (2) Exchanges between non-homologous chromatids carrying the a_1^T and the a_1 loci; (3) Exchanges by translocation, at the chromatid stage yielding heterozygous cells for three independent loci. Evidence has been obtained that variations occur at higher frequencies: (1) After gamma irradiation; (2) After treatment of buds with mitomycin C; (3) On strains which have gained an hereditary ability to vary at higher frequencies; abilities are specific for one type of variation; (4) At different development stages. The distribution of gamma induced variations on natural leaves shows that the response is a function of the cell division and differentiation gradients and that the variation probability is statistically constant from cell to cell for a given dose. The following conclusions are given: The primary physical effect of radiations is to induce the variations by a non-random intracellular response; some stage of the nuclear cycle must be particularly sensitive, causing higher variation frequencies than the true mutation frequency;

the marker genes can be modified by variation; because mutation can occur by a recombination process, reciprocal or not, between homologous or non-homologous chromatids, such events suggest either that homologous and homeologous chromosomes pair for recombination or their homologous DNA strands are neighboring during interphase, particularly when replication occurs; the probability for a given function to be restored becomes higher when equivalent information exists in the genome, localized in allelic or non-allelic sites, which could be called homeoallelic (genic redundancy); as discussed by Comings there exists a very elaborated chromatin organization during interphase. Both homo- and homeologous sequences or repetitive DNA's can be paired and regulated for synchronous replication. If complementary single strands can be hybridized and heteroduplex distortions repaired, rearrangements like conversions, transpositions, duplications are possible during somatic cell multiplication; and such mechanisms, operating at the DNA level, at single and double-strand stages, suggest that an enzymatic repair system has to be involved, in excisions and replications, as in microorganisms. (auth)

3559 EFFICIENCY OF MUTAGENIC TREATMENTS ON GAMETES AND ZYGOTES. Dommergues, P.; Cornu, A. (INRA, Dijon, France). pp 115-126 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974). (In French).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Inbreds and single hybrids of Petunia hybrida are used as test material. They carry anthocyanin marker genes, previously studied concerning linkage relationships and biosynthetic pathways. Hybrids obtained are heterozygotes for several marker genes. Induced phenotypic modifications are screened in F_1 (M_1 generation). Mutagenic treatments (γ rays and eventually EMS) are tried at different stages: (1) Pollen; (2) Ovules; (3) Both gametes before caryogamy; (4) Zygotes at G_1 stage; (5) Zygotes at G_2 stage. Doses of γ rays used differ according to the material: 5 to 30 kR on pollen; 1 to 4.5 kR on others; EMS 2.5‰ in water is used only for ovules and zygotes. Genetic events concerning each marker gene are detected by phenotypic observations and chromatographic analysis. Frequencies of events for each gene and each treatment per 1000 M_1 plants are summarized. After pollen treatment, the number of genetic events increases regularly with γ doses; optimum dose (maximum efficiency and satisfactory seed-setting) is around 15 to 20 kR: the observed frequencies of events for gene A is 30‰; for gene P_3 24‰; for gene P_1 20‰; for gene R 2.2‰. Efficiency of γ rays (optimum dose around 1 kR) on ovules and zygotes appears to be lower, ratios of events are 5 to 10 times lower, than after pollen treatment. However, because the zygote stage in Petunia is about 4 d at 20°C, it has been possible to demonstrate that the radiosensitivity of zygotes increases with age: for example, irradiation at the G_2 stage is much more efficient than at G_1 stage. Zygote treatment with EMS gives interesting results: event ratios are greater than with γ rays. Chimaeras are rarely obtained after pollen treatments. After zygotes treatments with γ-rays the chimaeric ratio grows with zygotes age; the observed maximum for anthocyanic variants reaches about 30%. Besides EMS treatments including delayed effects, a chimaeric ratio of more than 50% is often produced. (auth)

3560 GENETIC EFFECTS OF GAMETOPHYTE IRRADIATION IN DURUM WHEAT. Donini, B.; Devreux, M.; Scarascia-Mugnozza, G. T. (Centro Studi Nucleari della Casaccia, Rome). pp 127-138 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Spikes of durum wheat were acutely irradiated in the Casaccia gamma field (^{60}Co source) at different developmental stages of their gametophytes. The male and female gametophytes were separately irradiated at the total exposure of 1500 R (92.4 R/h) and the two gametophytes together received 750 R (46.9 R/h), and 1500 R (92.4 R/h), 2250 R (140.6 R/h), and 3000 R (187.5 R/h). The M_1 plants were harvested separately and for each M_1 plant unthreshed spikes, sown in sand in the greenhouse, were scored for chlorophyll and morphological mutations at seedling stage; moreover 44 seeds collected from one or two spikes in each plant were sown in the field for M_2 analyses to be carried out throughout the life-cycle of the plant. The analyses of the 68 segregating progenies, of the 2749 M_1 plants scored in the greenhouse, showed the presence of mutations in all the 444 spikes. Therefore, the treatment of haplophyte stages of the tetraploid species durum wheat leads to overcoming plant chimerism. The total mutation frequency, expressed as number of segregating progenies per 100 M_1 plants analysed throughout the life-cycle was 9.05 and 4.56 after irradiation of male and female gametophyte, respectively; the rate of mutations increases with the total exposure after both gametophyte irradiation and reaches 42.86% at 3000 R. The highest mutation frequency was reached in the progenies of M_1 plants which showed the lowest spike fertility. Furthermore, the mutation frequency shows insignificant difference regardless of the developmental stages irradiated at lower exposure while at higher exposures the mutation frequency increases with the stages of gametophyte development. (auth)

3561 INDUCTION AND SCREENING OF CHROMOSOMAL MALE-STERILE MUTANTS FOR USE IN THE PRODUCTION OF HYBRID WHEAT. Driscoll, C. J. (Univ. of New South Wales, Kensington, Australia). pp 139-142 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

A chromosomal male-sterility system of producing hybrid wheat involves (i) a ms gene on a wheat chromosome and (ii) a Ms gene on a homoeologous alien chromosome. ms Mutants are being induced with γ rays. Mutants on chromosomes 5B and 5A have been isolated and maintained as heterozygotes. These are being hybridized with lines containing chromosome 5R of rye in order to examine for fertility compensation and to produce X, Y, and Z lines. Irradiation of euploid pollen is thought to be the most satisfactory technique for isolation of ms mutants. (auth)

3562 USE OF INDUCED MUTATIONS IN SOLVING PROBLEMS OF NORTHERN CROP PRODUCTION. Kivi, E. I.; Rekunen, M.; Varis, E. (Hankkja Plant Breeding Inst., Hyryla, Finland). pp 187-194 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Near the ecological borders of any crop species, as in the northern agricultural areas, plant breeders often encounter plant physiological barriers that can be difficult to break because of the non-existence of the required gene resources among the spontaneous genotypes of species. This paper deals with efforts to use x- and ^{60}Co-mutations to solve certain typically northern problems of plant breeding. (a) Breaking the linkage between straw length and winter-hardiness in winter rye (Secale cereale). Only long-strawed rye varieties are hardy enough in Finland. These types are, however, poorly adapted to mechanical harvesting. Cross-breeding has not led to satisfactory results. Among the descendants of the ^{60}Co-irradiated Vjatka, a very winter-hardy Russian variety, families have been selected that have good winter-hardiness and much shorter straw than that of the mother variety. (b) Securing the winter-hardiness of a so-called young crop species, oil turnip rape (Brassica campestris oleifera). Growing was started in Finland in the 1940s and all varieties today are foreign ones. The best in winter-hardiness is Rapido from Svalöv. From a ^{60}Co-treated material of Rapido, families have been selected that seem to be positive micro-mutants also regarding winter-hardiness. (c) The optimal growth rhythm of spring barley (Hordeum volgare). Early maturing is, of course, one of the main characters of the northern varieties. For high yields, however, a long vegetative phase (from sowing to heading) is important. A two-rowed barley (Hja c4003) with this character has been selected from an x-irradiated material. Because of its straw-stiffness and wide adaptability it is a promising feeding barley. (d) The use of Mari-locus in producing a semi-dwarf six-rowed feeding barley. In the northern latitudes barley reacts to day-length sensitively, growing very tall. From a cross Mari × Otra, short stiff-strawed lines have been selected. One of these (Hja 4715) is being propagated for the northern latitudes. (auth)

3563 MODIFICATION BY ACUTE IRRADIATION OF RECOMBINATION FREQUENCIES IN TOMATOES. Monti, L. M.; Saccardo, F. (Centro Studi Nucleari della Casaccia, Rome). pp 233-240 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

To study the influence of the radiation treatments on the recombination frequencies, acute irradiations at different ontogenetic stages (zygotes, mature embryos, premeiosis, and meiosis) were applied on F_1 tomato plants that were heterozygous for several marker genes on chromosome 2. The results indicate that the recombination rates are not affected by zygote and seed

irradiation of F_1 plants; an increase of recombination is obtained only when buds of about 2 mm are irradiated, that is when treatment is applied at the male and female mother cell stage. The results are explained by assuming that at this stage the homologous chromosomes are already paired and that translocations between them are induced by the radiation treatments. (auth)

3564 ISOLATION OF ANEUPLOIDS ORIGINATING FROM INDUCED UNSTABLE CHROMOSOME ABERRATIONS. Saccardo, F.; Monti, L. M. (Centro Studi Nucleari della Casaccia, Rome). pp 277-287 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

After gamete irradiations on Pisum sativum, Lycopersicon esculentum, Triticum durum, Triticum dicoccoides, and Triticum timopheevi, several variegated plants were isolated in M_1 generation that are characterized by dicentric chromosomes. From the mitotic analyses that were performed on such M_1 plants of peas and durum wheat, two hypotheses may be formulated on the origin of dicentric chromosomes after mutagenic treatments. The first one postulates the formation of two telocentric chromosomes, derived from breakage of a chromosome at the centromere, and the fusion of one of them with another deleted chromosome. The second hypothesis implies the fusion of two deleted chromosomes. Satellited chromosome seems to participate very often in such rearrangements. Dicentric chromosomes, which appear to be transmissible only in peas and durum wheat, were found to give rise to ring chromosomes. Very high percentages of aneuploid plants were recovered in the progenies of variegated plants with dicentrics and rings. (auth)

3565 PHILOSOPHY AND ACCOMPLISHMENTS OF MUTATION BREEDING. Sigurbjoernsson, B.; Micke, A. (Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture, Vienna). pp 303-343 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

Mutation breeding has long been only a side branch of radiobiology and mutation research. Within recent years, however, an increasing number of new crop varieties bear features that result from induced mutations. It appears that, at least in certain crop species, techniques for induction of mutations and handling of mutated factors in breeding programs have developed to a stage when they should be considered for complementing any practical plant-breeding program. Further progress has to come primarily with regard to more efficient and economic screening techniques and with regard to adaptation of mutation techniques for certain crop species where they have not been used so far. (auth)

3566 INFLUENCE OF GAMMA IRRADIATION CONDITIONS ON SURVIVAL OF TOMATO MERISTEMS. Silvy, A. (CEN de Cadarache, St. Paul-lez-Durance, France). pp 345-354 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974). (In French).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

The usefulness of the conventional seed irradiation technique is limited mainly be the parallelism that exists between lethal and mutagenic effects. To overcome this difficulty, a methodological study based on the greatest radiosensitivity of cells in active life and their reaction to dose-rate was undertaken. The study involved semichronic treatments with gamma rays applied to whole plants (Primabel tomatoes of predetermined growth) at different stages of development from germination to floral differentiation. Taking the fertility of irradiated meristems as a criterion of survival, the following main results were found: (a) the dose-rate plays a decisive role; (b) the radiosensitivity of the terminal meristem is greater than that of the axillary meristems; (c) the same principle applies in the vegetative and floral differentiation stages: for each stage there is a threshold dose-rate which does not diminish fertility but sometimes retards flowering and increases the number of leaves; (d) pretreatment during the vegetative stage imparts greater resistance to irradiation at the floral stage; and (e) by establishing optimum irradiation conditions at the vegetative and floral stages, one can give whole plants aggregate doses similar to those applied to seeds, with preferential treatment of tissues involved in the formation of floral organs. This method yields complex chimaeras that in the second generation produce a mixture of hybrid plants and progeny in disjunction. (auth)

3567 MUTATIVE EFFECT OF REPEATED IRRADIATION WITH THERMAL NEUTRONS OR X-RAYS ON AN EIN-KORN-RAMSCH (SINGLE-GRAIN BULK) OF BARLEY. Walther, F. (Nuclear Research Establishment, Juelich, Ger.). pp 385-392 of Polyploidy and Induced Mutations in Plant Breeding. Vienna; International Atomic Energy Agency (1974).

From meeting on mutation and polyploidy and on improvement of mutation breeding techniques; Bari, Italy (6 Oct 1972). See STI/PUB-359; CONF-721034-.

A high mutation rate can help select more positive mutations in plants. Among several mutation-inducing methods the repeated irradiation of an "Ein-Korn-Ramsch" could be decisive. To get more detailed knowledge about such a successfully operating method, model investigations were done using diploid barley seeds. Dormant caryopses were treated with x rays (10 kR) or thermal neutrons (5×10^{12} n_{th}): bulks of single grains were irradiated in three successive generations and the mutative effect was measured by the rate of chlorophyll defect mutations. Changes were found concerning the number of spike progenies segregating mutations as well as the number of spikes containing more than one mutation. The influence of recurrent irradiation on survival rate, fertility, and mutability is discussed in connection with the practice of mutation breeding. (auth)

3568 CYTOGENETIC STUDY OF THE COMBINED EFFECT OF ETHYLENIMINE (EI) AND GAMMA RAYS ON CELLS OF CREPIS CAPILLARIS SEEDS IN TWO SUCCESSIVE MITOTIC CYCLES. Sidorov, V. P. (Inst. of General Genetics, Moscow). Genetika; 10: No. 2, 33-41(Feb 1974). (In Russian).

Combined treatment with EI at all the concentrations studied and with gamma rays at doses of 2 kR and 10 kR results in the increased yield of chromosome mutations in the first cell division. In the case of a combined effect of EI at a $4.6 \cdot 10^{-3}$ M concentration and of gamma rays at a dose of 2 kR there appeared aberrations of the chromatid type. The effect of a combined treatment with EI at $9.3 \cdot 10^{-3}$ M and $2.3 \cdot 10^{-1}$ M concentrations and with gamma rays at 2 kR and 10 kR did not exceed the effect of EI alone in the second cell division. The appearance of chromatid-type aberrations was observed in the first and the second cell divisions as a result of irradiation of previously soaked Crepis capillaris seeds at a 10 kR dose. (auth)

3569 INFLUENCE OF EXTREME TEMPERATURES ON THE GENETIC EFFECT OF RADIATIONS WITH VARIOUS LET. Valeva, S. A.; Fedin, P. I. (Inst. of General Genetics, Moscow). Tsitol. Genet.; 7: No. 5, 400-403(1973). (In Russian).

Both low temperatures (-78 and -196°C) and thermal shocks 60°C, used before and after irradiation of air-dry barley seeds with γ quanta and fast neutrons, caused a decrease in the damage, which was judged by the number of chromosome aberrations. The effect of modification increased with a rise in a radiation dose. In the experiments with fast neutron irradiation, the degree of the damage variability expressed more strongly than in the case of γ radiation. The paper shows for the first time the modification of the fast neutrons effect by low temperatures. (auth)

Radiation Effects on Animals

Refer also to abstracts 3530, 4118, and 5219.

Man

Refer also to abstracts 3138, 3502, 5215, 5694, 5695, 5701, and 5707.

3570 (AD-763751) AIRCRAFT RADIATION CODE ARC. Mooney, L. G.; Marslett, C. W.; Swanson, R. L. (Radiation Research Associates, Inc., Fort Worth, Tex. (USA)). 15 Apr 1973. Contract DASA01-71-C-120. 109p. (RRA-T-6302; DNA-3110-F). NTIS $3.00.

The Aircraft Radiation Code, ARC, is described for CDC-6600 and IBM 360/370 computers with full FORTRAN compilers. ARC is a fast-running radiation transport program which calculates the crew dose from nuclear weapons, accounting for aircraft attenuation, attitude, flight path, range, yield, fission-fusion ratio, altitude, neutron, air secondary γ rays, and fission-product γ rays with hydrodynamic enhancement. ARC requires as input angle-dependent attenuation factors for the aircraft to be obtained from a modified version of MEVDP. Alternatively, empirical attenuation factors may be used when less accurate results are acceptable. Air-transport data are obtained from ATR, or alternatively, from a simplified set of fitted data built into ARC. The aircraft maneuver before and following detonation may be described either in constant-g or constant radius terms. Diagnostic

features are incorporated for debugging. Typical problems require 12,000 words of core and execute in a few seconds. (auth)

3571 (AD-768753-6-GA) COMPUTERIZED RADIATION DOSIMETRY RECORDING SYSTEM. Marquiss, R. P. (Naval Ordnance Lab., White Oak, Md. (USA)). 8 Aug 1973. 50p. (NOLTR-73-145).

The maintenance of accurate and timely dosimetry records is one of the perpetual problems that plague the health physicist. Fortunately the modern digital computer is ideally suited to perform this task. Once properly programed, the computer will perform this task at a minimum cost and without the frequent computational errors that bother the human record keeper. One example of a method of keeping the required records through computerization is presented. (auth)

3572 (CEA-CONF-2502) USE OF CHROMOSOME ANALYSIS FOR IRRADIATION DOSIMETRY. Biola, M. T.; Le Go, R. [nd]. 14p. (In French). (CONF-730677-3). Dep. NTIS (U. S. Sales Only) $3.00.

From eighth congress of the association of radioprotection technicians; Chatenay-Malabry, France (8 Jun 1973).

The induction of primary chromosome lesions, their gradual growth, and the restoration errors altering the chromosomic morphology are outlined. The chromosome damage induced by radiation includes simple rupture, chromosome exchange, and anomalies in the number of chromosomes. The dose/effect relations relevant to the frequency of different types of anomalies in relation to the absorbed radiation dose are derived. The advantages of the use of cultured peripheral blood lymphocytes as a cellular population well adapted to the establishment of a biological radiation dosimetry are outlined. The technique used in this biological dosimeter and its advantages are discussed. (JSR)

3573 (CONF-720724-P1, pp 598-612) HUMAN RETINA AS A PARTICLE DETECTOR. McNulty, P. J. (Clarkson Coll. of Tech., Potsdam, NY). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

It is well documented that under the proper conditions the human retina will detect the passage of a charged particle. Detection by the retina takes the form of the subject exposed experiencing a visual sensation. The variety of particle-induced visual phenomena reported in the literature have been collectively labeled light flashes. The most dramatic as well as the greatest variety of light flashes have been experienced by the astronauts on Apollo missions 11 through 16 who observed them with frequencies that ranged as high as 1 to 2 per min. They reported the phenomena to be colorless and described a variety of forms including point-flashes or stars, streaks, double stars, and large flashes that would often fill a major portion of the field of view. Similar phenomena have been observed in the laboratory as a result of exposing human subjects to muons, neutrons, alpha particles, and nitrogen nuclei. To be an efficient detector, the observer must first adapt his eyes to rather complete darkness. Even then, it appears that the observer's detection efficiency will be subject to his physical and psychological state at the time of observing. (auth)

3574 (CONF-720724-P1, pp 613-623) PROBABILITY OF OBSERVING LIGHT FLASHES BY THE PASSENGERS ON SST PLANES. Young, P. S. (Mississippi State Univ., State Coll.); Fukui, K. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

According to the recent Berkeley experiments, single fast alpha particles (with K. E. of 240 MeV) produced flashes and streaks when they stopped in or penetrated the retina of the human eye. Since much higher fluxes of α particles are found at the SST levels than those of medium or heavy nuclei, the possibility of observing light flashes by SST passengers due to the α particles could not be ruled out. With this in mind, we measured the α-particle flux by use of a U. S. Airforce plane, which flew at the SST levels in 1970. Based on the measurements, we have tried to estimate such possibilities. The detailed accounts are given. (auth)

3575 (COO-1552-110) AREA PROGRAM IN POPULATION GENETICS. Progress Report. (Michigan Univ., Ann Arbor (USA). Dept. of Human Genetics). 1973. Contract AT(11-1)-1552. 41p. Dep. NTIS $5.25.

Progress is reported on a study of the genetic parameters of the Amerindians with specific reference to the Yanomama in South America. A small pilot study has now been initiated to study the genetic effects of the atomic bombs, employing biochemical phenotypes as indicators of mutation. A comparison of the frequency of private variants of 15 proteins in the Japanese, the South American Indian, and Caucasians is made. The derivation of mathematical and statistical aspects of population genetics is discussed. The demographic characteristics of the Yanomama were satisfactorily reproduced by computer simulation. The computer capabilities are described, but the analyses being supported by the AEC program in Population Genetics require more computing time than is available on the IBM 1130 system. Recommendations are made regarding upgrading of the computer. (MCW)

3576 (INIS-mf-760-8, pp 65-68) TWO-ISOTOPE MEASUREMENTS OF BONE MINERAL. Hoikkala, M.; Riihimaeki, E.; Spring, B. (Univ. of Helsinki). 1973.

From proceedings of the first national meeting on biophysics and bio-technology in Finland; Helsinki, Finland (4 Jan 1973).

The amount of apatite, and its proportion in bone mineral, was measured in the left arms of ten normal men and women by the attenuation of γ rays from ^{125}I and ^{241}Am. A pilot study indicated the adequacy of one isotope for measurement of the amount of apatite. Furthermore, it appeared that the total amount of dense material in bone is measurable by application of the two-isotope technique. (auth)

3577 (INIS-mf-887-2, pp 77-80) EFFECT OF RADIUM ON PRIMARY PRODUCTION ORGANISMS. Havlik, V. (Institut Hygieny a Epidemiologie, Prague). [nd]. (In Russian).

Model research is aimed at determining the laws governing the influence of radium on organisms, and at testing the feasibility of utilizing in practice the cumulative capability of water organisms in biological decontamination of radioactive waste waters discharged from uranium mines and reprocessing plants. (INIS)

3578 (INIS-mf-1111) BONE AS A DOSEMETER. Panepucci, H.; Mascarenhas, S. (Rio de Janeiro Univ. (Brazil)). 1972. 9p. INIS.

From first Latin-American conference on medical physics and radiation protection; Sao Paulo, Brazil (28 Feb 1972).

The production of paramagnetic centers was studied in room temperature bone irradiated by 45 kV x rays. The following results were found: bone of human, bovine, and canine origin gives all the same spectrum; the spectrum contains: a broad resonance at $g = 2.005$ proved to be related to collagen, annealing quickly at 60°C; a narrower line originated in mineral bone characteristic of random oriented axial centers having $g = 1.99$ and $g = 2.002$ and stable above 200°C; the production rate of the nonstable center can be explained by initial electronic filling of preexisting matrix defects followed by intrinsic defect production for higher doses. Considering its biological importance the use of EPR absorption of the more stable centers were investigated for dosimetry purposes. Initial results showed this to be possible in the rads to kilorads region for x rays with reproducible results. A log-log plot of signal intensity vs. dose was obtained with a slope of 0.7 which served as an approximate calibration for all bovine femur samples studied. The effect was also found in irradiated tooth enamel and its use in the study of biological process in bone metabolism is discussed. (INIS)

3579 (LA-tr-74-8) PARTICLE RAYS IN MEDICINE. Part I. Chorskov, V. S.; Dzelepov, V. P.; Goldin, L. L.; Lomanov, M. F.; Savcenko, O. V.; Tesch, S. Translated from Wiss. Fortschr.; 23: 303-309(1973). 22p. Dep. NTIS $3.25.

The theoretical advantages of heavy charged particle beams such as α particles, protons, and negative π^- mesons for radiotherapy of deep-seated neoplasms are reviewed and their RBE are compared with γ, electrons, and 220 kV x rays. The relationship of depth dose distributions and isodose curves to LET and the oxygen enhancement ratio is discussed. (CH)

3580 PREVENTION OF PNEUMONIA CAUSED BY POSTOPERATIVE ELECTRON IRRADIATION OF THE CHEST WALL FOR MAMMARY CANCER. Remodeling of Compensatory Filter, Protector, or Irradiation Pipe. Ashizawa, A.; Maeda, H.; Kimura, S.; Takao, R.; Kinoshita, H. (Nagasaki Univ.). Rinsho Hoshasen; 19: No. 1, 31-42(Jan 1974). (In Japanese).

In order to prevent pneumonia caused by the postoperative irradiation of the chest wall of mammary cancer, the compensatory filter and the thickness and quality of the covering board were selected and the irradiation pipe was remodeled. The stable 8 MeV with the lowest energy obtained from the 13 MeV LINIAC apparatus was used as the electron beam. The 12 mm acryl is suitable as the filter, and a 5 mm lead plate is required for covering the normal region. For reduction of the width of the pre-existing metal irradiation pipe, insertion of an acryl plate is practical, and leaked dose and scattered dose in the fibrous margin were negligible. The depth in the range of 80% effective dose of 8 MeV electron beam of each protector was 5 mm for acryl, 2.5 cm for modeling, 2 cm for oil clay, 1.9 cm for oil clay barite, and 1 mm for lead plate. Increase in the thickness of the acryl plate results in delayed outbreak of pneumonia, which is mild and is fixed

rapidly. If it is too thick, it introduces the area of sharp build down of the dose gradient which is a characteristic of electron beams, inside the chest wall, being in danger of producing lack of uniformity or insufficiency of dose in the chest wall. If mechanical remodeling is possible, an apparatus capable of emitting low energy should be built, and it is desirable to combine the corrected bolus by Mix D, aimed at obtainjng uniformity of the thickness of the chest wall. The x-ray shadow of chest by irradiation of 8 MeV was observed in all cases, regardless of the presence or absence of compensatory filter. However, the 12 mm acryl group were unconscious and asymptomatic, and shortening of the depth by 13 mm roughly agreed with the lowering from 8 MeV to 6 MeV. (JA)

3581 MISUSE OF X-RAYS. Steinert, R. (Sentralsykehuset, Akershus, Norway). Tidsskr. Norske Laegforen.; 94: No. 6, 347-350(28 Feb 1974). (In Norwegian).

The dangers of diagnostic medical radiation are emphasized and the frequency of unnecessary exposures, senseless repetitions, and interminable follow-up examinations is illustrated by three cases treated by the author in the course of one week. These patients had documented in the course of 11, 10, and 20 years respectively 186, 172, and 311 x-ray examinations, the great majority negative. One case, a woman assumed to be sterile had had many abdominal x-rays, in the last case it was later found that she was pregnant. It is stated that great carelessness is shown in protection of the gonads during such radiography, contrary to the very strict recommendations. (NO)

3582 RADIATION: RADIOGRAPHERS EXPOSED TO EXCESSIVE RADIATION. Accidents (London); No. 94, 29-32(1973).

Brief descriptions of four cases of exposure to sources of radiation are given. In the first case, two radiographers drove and parked a van containing a badly-sealed (poor design) source of radiation and received radiation overdoses. The other cases described are: exposure of an industrial radiographer to a radiation overdose through using unsuitable equipment (he removed the source from its container to make a panoramic examination of several pipes, instead of using the shutter to examine them one by one); a radiographer, thinking his assistant was elsewhere, switched on an industrial x-ray machine when the assistant was inside the irradiated enclosure, shut in by doors which were interlocked with the controls of the x-ray set; a bulldozer operator, ignoring radiation warning signs, dug open a storage pit containing a locked pipe containing a radiation source; the pipe had been removed to a scrap-yard for cutting, and the source was found unshielded. (Occup. Saf. Health Abstr.)

3583 INFLUENCE ON THE SKIN LOADING OF THE PLATE HOLDING THE LEAD BLOCKS MODIFYING THE IRRADIATION FIELD, USING TELECOBALT APPARATUS OF GRAVICERT TYPE. Dezsi, Z.; Miltenyi, L.; Vargha, G.; Patko, J.; Felszerfalvi, J. (Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). Magy. Radiol.; 26: No. 1, 48-52(Feb 1974). (In Hungarian).

Using Gravicert telecobalt therapeutic apparatus, with LiF thermoluminescent dosimeter, measurements were performed. On the basis of these measurements the authors came to the conclusion that the plexi-plate supporting the lead blocks that modify the irradiation field—placed 20 cm over the surface—does not increase the skin loading, if the radiation is performed perpendicularly. Besides the distance of the plexi-plate and the skin surface the radiation loading of the skin is dependent also on the extent of the radiation field. In the case of greater fields also the radiation loading of the skin increases. (auth)

3584 EFFECT OF IONIZING RADIATION ON THE SALIVARY GLANDS AND SALIVA. Garas, I.; Kyparissiadis, P.; Mafta-Pantazi, M. Odontostomatol. Proodos; 27: 37-44(1973). (In Greek).

This is a clinical and experimental study based on patients suffering from carcinoma of the head and neck, as well as on animals. Both patients and animals underwent radiotherapy on the region of the salivary glands either with X-rays (200 KV) or with gamma radiation of a cobalt unit. The study of the effect of the ionizing radiation on the salivary glands is based on the noted histological changes of the glands, and the effect of the saliva is based on the noted changes of the pH. (auth)

3585 ASSOCIATION OF ILLNESSES WITH ABNORMAL IMMUNOLOGIC FEATURES WITH IRRADIATION OF THE THYMIC GLAND IN INFANCY: A PRELIMINARY REPORT. Hempelmann, L. H. (Univ. of Rochester, NY); Grossman, J. Radiat. Res.; 58: No. 1, 122-127(Apr 1974).

In a mail survey of 2,872 persons treated with x rays in infancy for alleged thymic enlargement information was obtained suggesting an increase in the frequency of asthma and of rare illnesses with altered immunologic features. The respective frequencies of asthma and rare illnesses in the irradiated population were reported to be two and three times those in the nonirradiated siblings. Tests in a small sample of the irradiated population, however, did not reveal evidence of immunologic deficiencies or aberrations. The study was designed to determine the incidence of radiation-induced neoplasms in the irradiated population. The incidental finding of an increase in rare diseases with immunologic features was unlikely to be explained by chance. Such diseases could be related to radiation damage of the thymus gland in infancy. (auth)

3586 PROPOSAL OF A PROGRAM OF CONTROLLED HEMATOLOGIC STUDIES IN THORIUM X THERAPY OF BECHTEREW'S DISEASE. Thiele, M.; Stieglitz, R.; Stobbe, H.; Wegner, G. (Humboldt Univ., Berlin). Beitr. Orthop. Traumatol.; 20: No. 6, 310-315(Jun 1973). (In German).

The injury to the hematopoietic system during Th X (^{224}Ra) therapy of Bechterew's disease requires special attention. A graduated monitoring and control system of prophylaxis, monitoring, and supplementary care is recommended. In the event of suspicious findings a more accurate investigation called a function diagram is recommended. (tr-auth)

3587 RADIOTHERAPY OF PRIMARY LUNG CANCER BY ^{60}Co DELIVERING 600R TWICE A WEEK. Sasaki, I. (Kobe Univ., Japan). Haigan; 13: No. 1, 41-51(Mar 1973). (In Japanese).

One hundred and thirty nine patients with primary lung cancers were treated by ^{60}Co from 1964 to 1971. A single dose of 600 R was given twice a week. The total dose used was from 6000 R to 8400 R over a period from 5 to 7 weeks in most cases. One hundred and forty eight patients as control treated by daily dose of 200 R six times per week were compared with this trial. The consequence of the studies was evaluated by crude survival rate, median survival months, and tumor regression rate. The case irradiated with 600 R twice a week showed a better therapeutic effect than control. In regard to skin reactions, erythema, and dry reactions occurred in most cases, but most reactions occurred in only two cases. Pulmonary pneumonitis was seen in about 60% of cases between the end of and 3 months after the treatment. In cases irradiated with 8000 R or more, pneumonitis occurred in almost all cases within 2 months from the beginning of the treatment. But, administration of medicines eliminated severe symptoms. White cells were examined once a week in all cases. A count of 3000/mm^3 white cells was regarded as a minimum for further irradiation. White cell counts of more than 4000 were 54.9%, 4000 to 3000, 40.7%, and below 3000, 4.4% respectively. Thrombocytes below 100,000/mm^3 were seen only in a few, and red cells showed no appreciable change. Tumors were regressed approximately the same degree by both types of treatments without side effects. In the treatment, anti-tumor drugs and hyperbaric oxygen therapy were used during unirradiated time. (auth)

3588 WALLENBERG SYNDROME IN THE CASE OF LATE X-RAY DAMAGE OF THE MEDULLA OBLONGATA. Volk, B.; Busse, O.; Brusis, T. (Univ., Heidelberg). Nervenarzt; 44: No. 7, 373-377(Jul 1973). (In German).

Due to an otologically and neuroradiologically detected chemodectoma protruded into the tympanic cavity, a 60 year old female patient had been treated with telecobalt pendulum and standing-field irradiation with a total foval dose of 9,100 Rad for a period of four and a half months. About seven months after the last irradiation, symptoms similar to those of a Wallenberg Syndrome were first observed, followed by a clear deterioration in the patient's condition within a few weeks. The patient died nine and one half months after the last irradiation from bronchopneumonia. The post-mortem examination revealed a dysoric affection of the walls of the intramedullary vessels with plasmatic infiltration necrosis of the tissue in the dorso-lateral third of the medulla oblongata. The afferent vessels were not affected. (GE)

3589 RISK OF THE OUTBREAK OF FIBROSIS IN THE LUNGS IN THE COMBINED TREATMENT WITH RADIATION AND BLEOMYCIN (BLM). Awazu, R. (Shikoku Cancer Center, Japan). Rinsho Seijinbyo; 3: No. 7, 1099-1103(Jul 1973). (In Japanese).

Examined were the incidence, pathologic conditions, and risk of fibrosis in squamous cell carcinoma treated with bleomycin (BLM) administration and radiotherapy combined. Bleomycin was orally administered to nine cases and Bemp to 6 cases for comparison. The dose of LINAC irradiation ranged from 2000 R to 8000 R. In the use of BLM, fibrosis developed in three of the nine cases, all dying. In the case of Bemp, it developed in two of the six cases, one of whom died. For the treatment of fibrosis, a large dose of long-active-steroid was used simultaneously with the outbreak. The characteristic of the fibrosis is thought to be the addition of pneumonia to the symptoms of BLM-fibrosis. On chest x-ray film, diffuse and fine, granule-shaped reticular shadows, or dotted shadows were spread from the site of LINAC irradiation, or from the inferior portion of the lungs upward. There was a persistent, long-lasting, stimulative cough, accompanied by bloody phlegm in many cases. Discontinuation of the steroid administration resulted

in a fever. Cases of Bemp were milder than those of BLM. It was thought therefore that in the single use of BLM, a total dose of 150 mg (15 mg × 10) would decrease the incidence of fibrosis and in Bemp, that of 75 mg (7.5 mg × 10). Since the symptoms of Bemp-fibrosis were milder than those of the single use of BLM, if any, it was suggested that the former was safer. No significant difference was observed between the dose of LINAC irradiation and the total dose of BLM. (JA)

3590 TOTAL BODY IRRADIATION IN THE TREATMENT OF CHRONIC LYMPHOGENOUS LEUKEMIA: JANEWAY LECTURE, 1973. del Regato, J. A. (Penrose Cancer Hospital, Colorado Springs, CO). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 504-520(Mar 1974).

From fifty-fifth annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

Total body irradiation is a satisfactory procedure in the palliative treatment of chronic lymphogenous leukemia. An initial series of 10 daily irradiations of 10 R may be safely followed by weekly exposures of 5 R and annual boosters of 100 R delivered in 10 days. Patients have been kept on this regimen for periods of 4 to 7 years. In a series of 61 patients so treated the average survival was 46 months, with a maximum of 15 years, a minimum of 2 months, and a 5 year survival of 21 per cent. Autopsies performed in one-third of these patients failed to reveal one instance of untoward radiation effects. Total body irradiation has to be complemented by regional irradiation of spleen and lymphadenopathies. Those organs frequently found involved at autopsy such as kidneys, lungs, etc. should perhaps be similarly irradiated at very moderate doses. Statistical study of the survival data suggests the presence of 2 different subgroups in the sample. (auth)

3591 NODAL RECURRENCES FOLLOWING RADICAL RADIATION THERAPY IN HODGKIN'S DISEASE. Rubin, P.; Keys, H.; Mayer, E.; Antemann, R. (Univ. of Rochester, NY). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 536-548(Mar 1974).

From fifty-fifth annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

The re-appearance of nodal disease following radical irradiation with extended field technique (mantle or inverted Y) can rarely be controlled by further aggressive irradiation. The majority of nodal recurrences, regardless of how localized they are, eventually progress to extranodal sites. Managing nodal recurrences with irradiation often presents special problems due to overlap of fields and to risk of re-irradiation of vital normal structures, especially the spinal cord. A retrospective review of 123 patients with clinical Stages I and II Hodgkin's disease who have been treated with either extended field irradiation (mantle technique) or total nodal irradiation is presented. The 5 year survival rates after the first relapse are: 50 per cent for patients with local nodal recurrence; 27 per cent for patients with transdiaphragmatic nodal extension; and 0 per cent for those with disseminated disease. The transdiaphragmatic extension, which is the most common recurrence pattern after treatment with mantle irradiation, has been eliminated by elective irradiation of paraaortic nodes utilizing the total nodal irradiation technique. (auth)

3592 TIME DOSE FACTORS IN RADIATION INDUCED OSTEITIS. Kim, J. H.; Chu, F. C. H.; Pope, R. A.; Woodard, H. Q.; Bragg, D. B.; Shidnia, H. (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 684-690(Mar 1974).

From fifty-fifth annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

Sixty-eight patients with varying degrees of radiation-induced bone damage were studied in detail with respect to the absorbed doses in soft tissue of bone and the time-dose-fractionation treatment schemes employed. The cases were divided into 2 large categories of bone damage. The first category included 52 cases of predominantly irreparable injuries; the second included 16 cases of reparable damage. Average values of the NSD (Nominal Standard Dose) required for irreparable osseous injury ranged from 2,120 rets to 3,200 rets (roentgen equivalent therapeutic) depending on site. The average NSD value for reparable osteopathy was in the range of 1,310 rets. Analysis of iso-effect dose curves indicated varying degrees of dependency on the number of fractions or over-all treatment time for the production of radiation osteitis. Preventive measures such as careful treatment planning, utilization of supervoltage irradiation, and avoidance of trauma and infection are stressed. (auth)

3593 TESTOSTERONE POTENTIATED RADIOPHOSPHORUS THERAPY OF OSSEOUS METASTASES IN PROSTATIC CANCER. Edland, R. W. (Gunderswn Clinic. Ltd., La Crosse, WI). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 678-683 (Mar 1974).

From seventieth annual meeting of the American Roentgen Ray Society; Montreal, Canada (25 Sep 1973).

Testosterone potentiated radiophosphorus therapy remains a most effective form of treatment for patients with widespread, painful, osseous metastases from prostatic adenocarcinoma. Including the series in a total population of 174 patients, 86 per cent of the courses administered were effective in promptly relieving pain to a significant degree. This is not the treatment of choice when soft tissue metastases are the predominant feature, and extensive vertebral involvement with incipient cord compression should be approached cautiously if testosterone potentiation is to be employed. Depression of hematopoietic elements may occur, but is usually minimal, unless multiple courses are given; then, thrombocytopenia is the most serious sequela. This treatment combination deserves a prominent place in therapeutic armamentarium for patients with diffuse prostatic carcinoma. (auth)

3594 EVALUATION OF THE EFFECTS OF SPLENECTOMY IN HODGKIN'S DISEASE IN PATIENTS UNDERGOING EXTENDED FIELD OR TOTAL LYMPH NODE IRRADIATION. Royster, R. L. Jr.; Wassum, J. A.; King, E. R. (Virginia Commonwealth Univ., Richmond). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 521-530(Mar 1974).

From fifty-fifth annual meeting of the American Radium Society; Colorado Springs, CO (22 Apr 1973).

A retrospective study of 91 patients with Hodgkin's disease, treated by irradiation, was undertaken to compare the hematologic tolerance in splenectomized and nonsplenectomized cases. The cases were analyzed according to several parameters, and the results are discussed. The authors believe that the data presented here demonstrate a better hematologic tolerance to extended field and total lymph node irradiation in the splenectomized patient as compared to the nonsplenectomized patient who is receiving similar treatment. Results confirm the observations of other investigators in similar studies, even though the data were not evaluated for statistical significance. (auth)

3595 DOSE CALCULATION FOR TUMORS IN RADIOTHERAPY. Lima Basto, E. Arq. Patol. (Lisbon); No. Special Suppl., 25-33(Feb 1972). (In Portuguese).

It is shown that it is necessary to determine the skin dose in radium therapy. The depth dose should also be calculated in order to know more completely the actual dose received by the tumor. In practice for the calculation of the depth dose in man depth dose tables can be used. These tables are obtained with water phantoms. When the irradiation beam passes through bony tissue the doses indicated by the water tables should be reduced. In irradiation of pulmonary fields the actual dose is higher than that given by the absorption of water. The study of the actual dose should be done by direct methods if at all possible. (tr-auth)

3596 INTRODUCTION TO THE SYMPOSIUM ON PERMISSIBLE DOSES OF IONIZING RADIATION. Davids, J. A. G. Atoomenergie Haar Toepass.; 15: No. 7-8, 163-166(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

A symposium on permissible doses of ionizing radiation, organized by the Netherlands Radiobiological Society, was held in Groningen on April 26, 1973. In this introductory paper dose concepts and units as well as the exposure of the general population from various radiation sources are briefly described. (auth)

3597 FUNDAMENTAL ASPECTS OF THE RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIATION PROTECTION. Barendsen, G. W. Atoomenergie Haar Toepass.; 15: No. 7-8, 167-170(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

A review is given of general considerations on which the recommendations of the ICRP are based. The aim of setting dose limits is described as the reduction of the total amount of somatic and genetic damage to a level which is considered acceptable in view of the social and economic advantages associated with the applications of ionizing radiation and radionuclides. (auth)

3598 RISKS OF TUMOR INDUCTION BY SMALL RADIATION DOSES. van Putten, L. M. Atoomenergie Haar Toepass.; 15: No. 7-8, 176-182(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

The hazards of tumor induction are reviewed and assessed for small radiation doses associated with various levels of ionizing radiation, up to about twice the natural background. A distinction is drawn between leukemia incidence, for which many radiation-linked statistics are now available, and other cancers for which

relevant data are more scanty. Special attention is given to the effects of intrauterine exposure, and to the existence of high-risk groups. (auth)

3599 IONIZING RADIATIONS AND GENETIC RISKS. Sankaranarayanan, K. Atoomenergie Haar Toepass.; 15: No. 7-8, 183-188(Jul 1973).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

Estimates of genetic risks to man from exposure to ionizing radiations are to a large extent based on the results of studies with experimental mammals, notably the mouse. From these studies it appears that the risk is considerably less at low dose-rates and small doses (i.e., under conditions where most of the genetically significant dose to the human population is delivered) than it was estimated to be when the standards were set in the mid-fifties for the maximum permissible levels of radiation. (auth)

3600 EFFECTS OF PRENATAL IRRADIATION. Vos, O. Atoomenergie Haar Toepass.; 15: No. 7-8, 189-192(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

A survey of the effects of ionizing radiation on mammalian embryos and fetuses known from the literature is presented. Studies with experimental animals (mainly rats and mice) have shown that three periods during the prenatal development can be recognized; each period is characterized by a certain type of radiation effects. In man the most frequent effects found are mental retardation and decreased head circumference. The problem of minimal dose-effect relationship is discussed. (auth)

3601 PUBLIC DISCUSSION ON PERMISSIBLE DOSES OF IONIZING RADIATION. Davids, J. A. G. Atoomenergie Haar Toepass.; 15: No. 7-8, 193-200(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

Recent public discussion on radiation protection standards for the general population is reviewed and summarized with particular reference to the potential hazards from proliferating nuclear power stations. Considerable space is devoted to the arguments between Sternglass and his critics, the latter claiming that Sternglass's analysis exaggerates the risks. (auth)

3602 EFFECT OF GRANULOCYTOPENIA, MARROW SUPPRESSIVE DRUGS, AND INFECTION ON MARROW RETICULOENDOTHELIAL PATTERNS. Henry, R. E.; Fletcher, J. W.; Solaric-George, E.; Donati, R. M. (St. Louis Veterans Administration Hospital). J. Nucl. Med.; 15: No. 5, 343-348(May 1974).

Reticuloendothelial (RE) marrow extension beyond the proximal one-third of the femur and humerus was observed in 19 of 38 studies performed on 26 patients with Hodgkin's disease or lymphoma. All of the patients demonstrating RE marrow extension had been treated with radiation, chemotherapy, or a combination of both. None of the untreated patients demonstrated RE marrow extension. A significant association with granulocytopenia was noted in patients with Hodgkin's disease or lymphoma demonstrating RE marrow extension. A similar association was seen in five additional patients with either renal transplant or metastatic carcinoma rendered granulocytopenic by immunosuppression or chemotherapy. Examination of an additional 13 patients with granulocytopenia not associated with chemotherapy did not reveal RE marrow extension. However, RE marrow extension in association with granulocytosis was observed in four of an additional seven patients with acute bacterial infection and no primary hematologic disease. Serial studies in patients with Hodgkin's disease or lymphoma revealed an association between the extending RE marrow pattern and intolerance to chemotherapy in three patients whereas three other patients without marrow extension tolerated chemotherapy well. These data suggest that RE marrow extension following chemotherapy and radiation is due to compromised hematopoiesis reflected by granulocytopenia. The appearance of an extended RE marrow pattern following chemotherapy appears to be predictive of poor tolerance to further chemotherapy whereas nonextension of the RE marrow reflects adequate marrow granulopoietic reserve. Subclinical infection cannot be completely excluded as a cause of RE marrow extension in patients with chemotherapy-associated granulocytopenia. (auth)

3603 ULTRAVIOLET ERYTHEMA: A STUDY ON DIFFUSION PROCESSES IN HUMAN SKIN. Van Der Leun, J. C. Utrecht; State Univ. of Utrecht (1966). 164p. University Microfilms Order No. 73-31,302.

Thesis (Ph. D.).

The current theory of ultraviolet erythema, in which the vasodilation in the dermis is effected by a mediator substance diffusing from the epidermis, is given a mathematical formulation. Relationships derived from this diffusion theory are compared with observations. The observational methods are described in separate chapters, on dose-time relationships, lateral extensions of the erythema, temperature of the reddened skin, and on in vivo measurement of the epidermal thickness. Several new differences between the 300-nm and the 250-nm erythemas are reported. For example, the latent time of the 300-nm erythema is equal in different skin regions; that of the 250-nm erythema varies with the skin region. The lateral extension of 300-nm erythemas significantly exceeds that of 250-nm erythemas. A 300-nm erythema of sufficient intensity is, during a certain time interval, accompanied by increased skin temperature, whereas 250-nm erythemas are not. The observations on the 300-nm erythemas are in reasonable agreement with the diffusion theory. Certain long-known facts are explained and the problems that remain are posed more sharply. Consideration of the diffusion coefficient of the mediator substance in the epidermis leads to the conclusion that the mediator substance is not necessarily macromolecular. The examination of this diffusion process gives as a by-product certain information on the epidermis. Diffusion in the viable layer of the epidermis proceeds much more slowly than in water. An observation on the 300-nm erythema suggests that the thickness of the viable layer is controlled via a diffusion process through the layer itself; this control may be exercised by the glucose supply. The observations on the 250-nm erythemas show a less satisfactory correspondence with the diffusion theory. The correspondence is improved if it be assumed that the mediator substance is broken down more rapidly than that of the 300-nm erythema, but this does not resolve all contradictions. In several instances, the alternative theory of direct action of the radiation at the level of the blood vessels gives better agreement with the 250-nm observations. As a synthesis of the available data, the hypothesis is advanced that there are two distinct types of ultraviolet erythema; the first caused by action of the radiation on the dermis, occurring in the entire ultraviolet wavelength region, and the second caused by action of the radiation on the epidermis, occurring only in a narrow wavelength range near 300 nm. Both types of ultraviolet erythema are subject to photorecovery. (Diss. Abstr. Int., B)

3604 SCATTERED RADIATION DOSAGE AS A FUNCTION OF X-RAY ENERGY. Keller, B.; Mathewson, C.; Rubin, P. (Univ. of Rochester, NY). Radiology; 111: No. 2, 447-449(May 1974).

The scattered radiation dosage to critical structures not in the treatment field may play an important role in the outcome of radiation therapy. Scattered-dose data for ^{60}Co gamma rays and for 2, 4, 6, 8, and 10 MV x rays are given and the dosage to distant structures is calculated. Correlation between measured and calculated doses for ^{60}Co and 2 MV x rays is also described. (auth)

3605 PATIENT DOSE DURING FIELD SETUP WITH A THERAPY SIMULATOR. Anderson, D. W.; Fahey, L. J.; Bogardus, C. R.; Adams, G. D. (Univ. of Oklahoma, Oklahoma City). Radiology; 111: No. 2, 417-419(May 1974).

The exposure rate and central axis per cent depth dose for the fluoroscopic beam of a simulator were determined as a function of current, peak kilovoltage, and target-skin distance. From data on beam parameters and time elapsed for fluoroscopic setup of therapy fields, the doses for 72 patients were determined. The average fluoroscopic time of three minutes per field produced a surface dose of 19 rads and a midline dose of 4 rads. Radiation safety considerations relating to these exposures are discussed. (auth)

3606 TABLES FOR CALCULATION OF NOMINAL STANDARD DOSE FOR COMPLEX TREATMENT SCHEDULES. Phelps, H. M.; Phelps, C. E. (Maine Medical Center, Portland). Radiology; 111: No. 2, 411-414(May 1974).

Tables with instructions and examples are presented which allow calculation of NSD values for complex treatment schedules with gaps or changes in fractionation pattern. These are based on a previously derived formula, and eliminate the need for a computer to calculate these values. (auth)

3607 CONGENITAL MALFORMATIONS AND ENVIRONMENTAL INFLUENCE: THE OCCUPATIONAL ENVIRONMENT OF LABORATORY WORKERS. Yager, J. W. (Univ. of California, San Francisco). J. Occup. Med.; 15: No. 9, 724-728(Sep 1973).

Statistics concerning the number of infants born with congenital malformations are presented and a table is given to show the prevalence of common birth defects each year in the United States. The chance of exposure to teratogenic agents by pregnant laboratory workers and nurses was great. The following groups of teratogenic environmental factors are discussed: physical agents such as ionizing radiation and radioisotope tracers; drugs; chemicals other than drugs; and biologic agents. A study of safety standards showed that standards are often ill-defined and difficult to enforce. (HLW)

3608 14 DEATHS AMONG 165 SERIOUS RADIATION CASES SINCE 1945. Majborn, B. (Danish Atomic Energy Commission, Risoe). Ingenioer-nytt; 10: No. 6, 3-5(8 Feb 1974). (In Norwegian).

Serious radiation accidents since 1945 are reviewed, both those due to criticality accidents and accidents with radiation sources. Cases given main consideration include the SL-1 accident, the Mexican family case in 1962, the Argentinian welder case in 1968, the Lockport accident in 1960, the irradiation of Marshall Islanders and Japanese fishermen in 1954 and the Windscale accident. The object of the article is to set such accidents in perspective in light of the heated nuclear controversy. (NO)

3609 MANREM IN WORKING ENVIRONMENTS IN NUCLEAR POWER PLANTS. Delpla, M. Pollut. Atmos.; 15: No. 57, 17-57(Jan 1973). (In French).

From international congress on occupational health; Buenos Aires, Argentina (17 Sep 1972).

The manrem is defined from a mathematical expression for the damage caused by irradiation. The irradiation of groups of workers in nuclear power plants is then discussed, the damage corresponding to this irradiation being theoretically evaluated. The values obtained are also discussed. (INIS)

3610 UTILIZATION OF A SILICON DETECTOR FOR INTERNAL DOSE MEASUREMENTS IN TELE-COBALT-THERAPY OF UTERUS NECK CANCER. Terlecki, J.; Kobierska, A.; Karnicka-Miodkowska, H.; Ostrowska, T. (Medical Academy, Danzig) Postepy Fiz. Med.; 7: 209-213(1972). (In Polish).

A silicon detector of the type GD-1 was evaluated for dose penetration measurements in ^{60}Co γ therapy. The examination was carried out with the patients undergoing radiotherapy for cancer of the uterus neck. The measured doses were compared to those made in a theoretical way. The differences range about ±2 to 13%, where for obese persons they were a little bit greater. The possibility of direct measurements may allow a more precise planning of the cure in selected cases. (auth)

3611 VALIDITY OF RISK ESTIMATES OF LEUKEMIA INCIDENCE BASED ON JAPANESE DATA. Rossi, H. H.; Kellerer, A. M. (Columbia Univ., New York). Radiat. Res.; 58: No. 2, 131-140(May 1974).

On the basis of all available pertinent radiobiological evidence it must be expected that the RBE of neutrons for the induction of human leukemia is a function of absorbed dose. An analysis of epidemiological and dosimetric data obtained at Hiroshima and Nagasaki yields results that conform to this expectation. It must, therefore, be concluded that the shapes of the dose-effect curves for the two Japanese cities are different and among the simplest assumptions that may be applied a linear dose dependence for neutrons appears to be the most plausible. Risk estimates based on a linear dependence for gamma radiation must, therefore, be excessive. (auth)

3612 SPECIFICATION OF UNITS FOR NATURAL URANIUM AND NATURAL THORIUM. Statement of the National Council on Radiation Protection and Measurements (NCRP). Radiat. Res.; 58: No. 2, 286-287(May 1974).

The special curie for natural uranium led to confusion and its use compromised the integrity of the curie as a unit; therefore the NCRP recommends that the use of the special curie be discontinued and that mass units be used to define quantities of natural uranium as they appear in the specification of MPC and MPBB values. The NCRP also recommends that the special curie definition for natural thorium be discontinued and further recommends that the use of a limiting concentration for natural thorium as an entity be discontinued and that the established MPBB and MPC values for each of the individual thorium isotopes be utilized instead. (HLW)

3613 RADIATION-INDUCED HEAD AND NECK TUMOURS. Modan, B.; Baidatz, D.; Mart, H.; Steinitz, R.; Levin, S. G. (Sheba Medical Center, Tel Hashomer, Israel). Lancet; 1: No. 7852, 277-279(23 Feb 1974).

About 11,000 children irradiated in Israel for ringworm of the scalp (Tinea capitis) and two matched control groups were retrospectively followed up for twelve to twenty-three years. The irradiated group had a significantly higher risk of both malignant and benign head and neck tumors, especially those in the brain, the parotid gland, and the thyroid. This is believed to be the first definite demonstration of the role of ionizing radiation in the aetiology of brain tumors in man. (auth)

3614 LYMPHOCYTE RESPONSE AFTER RADIOTHERAPY. Byfield, P. E.; Stratton, J. A.; Small, R. (Univ. of California, Los Angeles). Lancet; 1: No. 7852, 309(23 Feb 1974).

Evidence is presented for the sensitivity of B lymphocytes as well as T lymphocytes in patients, during the course of mediastinal or pelvic radiotherapy (total dose 4000 to 5000 rads). The data are presented in tabular form as contrary to those of a previous worker (Braeman, Lancet, p683, (Sept. 22, 1973)). (UK)

3615 INTERNATIONAL COMPARISON OF MEASUREMENT PRECISION OF PERSONAL EXPOSURES TO IONIZING RADIATION. Hecker, O. (Board of Standardization, Berlin); Jankowski, J.; Kodl, O.; Kraus, W.; Musialowicz, T.; Referowski, Z.; Rothe, W.; Singer, J.; Trousil, J.; Wysopolski, J. Health Phys.; 26: No. 4, 349-351(Apr 1974).

A comparison of measurement accuracy has been carried out in three national laboratories in the Czechoslovak Socialist Republic, German Democratic Republic, and Polish Peoples Republic where the film dosimetry method is used for personal exposure measurement. This was done so that comparisons of radiation exposures of personnel engaged in radiation work in the three countries could be compared with confidence and also to dispel the widespread belief that errors in film dosimetry are unacceptably high. The comparison was carried out in three stages. The first comprised the comparison of precision of γ exposure measurement over the exposure range from 50 mR to 20 R with arbitrary energies above 200 keV. The second stage comprised the comparison of precision of x-ray exposure measurement with energies corresponding to a high or low filtered source with an x-ray tube voltage of about 20 to 200 kV and exposure range from 50 mR to 2 R. The third stage involved the comparison of measurement precision of mixed x radiations of various energies and of mixed x- and γ-radiations. Results of the comparison are tabulated according to stages. It was shown that the accuracy of the measurements in the three countries is sufficient to allow mutual comparison of results and that it is not necessary to replace the film dosimetry method as far as errors in routine performance are concerned. (UK)

3616 ACTION OF PENETRATING RADIATION ON BIOENERGETIC PROCESSES IN THE TUMORS. Baysakhatov, R. Zdravookhr. Turkm.; No. 4, 7-10(1973). (In Russian).

On the basis of the analysis of literature data it is proposed that the tumor radiosensitivity differs sharply by the criteria of bioenergetic processes. Some types of malignant tumors respond to the radiation by interruption of mitochondrial and nuclear oxidative phosphorylation and by disorganization of the enzyme systems of the glycolytic route early after radiation exposure; other types of tumors exhibit their reaction weakly, at later times, not immediately. (Ref. Zh.)

3617 CLINICAL PICTURE AND RESULTS OF THE TREATMENT OF OCCUPATIONAL BRONCHOGENIC CANCER DUE TO IONIZING RADIATION. Suda, J.; Macholda, F.; Rehak, F. Stud. Pneumol. Phtiseol. Cech.; 32: No. 5-6, 259-262(Jun 1972). (In Czech).

Observations made from 1962 to 1969 in a group of uranium miners suffering from bronchogenic cancer are reported. It is shown that occupational carcinoma in uranium miners differs much from usual lung cancer as regards frequency and other characteristics. The duration of exposure to ionizing radiation was in 80% of the cases 5 to 15 yrs, and the mean age of patients 53.1 yrs. As regards the histological picture, the anaplastic (small-cell) type predominated over the pavement-cell type (58 against 26%). The course of the disease was in general very rapid; treatment and even surgery had little effect. Only 5% of the patients survived 3 years after diagnosis. It is thought that there are other specific factors besides ionizing radiation in Czechoslovak uranium mines to have a direct or indirect effect on the occurrence of lung cancer. (Occup. Saf. Health Abstr.)

3618 RADIATION PROTECTION IN THE GERMAN DEMOCRATIC REPUBLIC DURING USE OF IONIZING RADIATION IN MEDICINE. Schuettmann, W. (Staatlich Zentrale fuer Strahlenschutz, Berlin). Radiol. Diagn.; 13: No. 3, 427-435(1972). (In German).

A survey on radiation protection for the medical use of ionizing radiation in the GDR is given. Whereas the present state of radiation protection for the use of ionizing radiation in medicine largely excludes somatic injuries in occupationally exposed persons, the possibility of a genetic damage for users and patients has to be carefully considered in view of the increased medical use. A likewise increasing genetic exposure of the population due to other occurrence of ionizing radiation involved in civilization is parallel to the increase. This situation proves the necessity to include the medical use of ionizing radiation in a system solution of radiation protection as it exists in the GDR. Legal regulations and measures for the permit and control of medical radiation units are given. Furthermore, the personal dosimetrical and medical control of the occupationally exposed persons is described, the cooperation of the sector of radioprotective medicine of the State Centre of Radiation Protection being especially entered into. The necessity

of elaborating radioprotective principles for decreasing the genetic radiation dose to the patients is given reasons for. The importance of training and further education in the field of radiation protection is pointed to. (auth)

3619 RADIOPROTECTION IN THE PROPOSED NUCLEAR MEDICINE CENTER AT LYON. Berger, M. (Univ., Lyon). pp 365-374 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

The center, which is currently under construction, will open its door towards the end of 1973. The building has a surface area of 3,200 m^2 and two floors. It is designed to accomodate 10 hospitalized patients and about 30 consultants per day. The following aspects of the building and its construction are discussed: the architectural disposition taken in order to ensure an adequate level of radioprotection (division of the building into three zones: controlled zone, monitored zone, and free zone); study of the movement of personnel within the building, the patients, and the radioelements; the measures envisaged for the storage and handling of radioelements; the design of circuits for disposing solid, and gaseous wastes as well as the storage of such wastes before their safe disposal into the environment; the most important aspects of the policies which will be adopted for the control of personnel, the responsibility of which will be delegated to the senior health physicist. (FR)

3620 SHARED-TIME COMPUTER APPLICATIONS IN COBALT THERAPY DOSIMETRY. Dutou, L. (Centre de Lutte Contre le Cancer Leon-Berard, Lyon). pp 355-364 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From 7th national congress on control of ionizing radiation; pollution, dosimetry, applications; Marseilles, France (16 May 1972).

Cobalt therapy dosimetry involves the introduction of long and difficult calculation techniques into routine procedures. It is for this reason that the utilization of computer techniques is envisaged. Many programs have been written for this purpose, these programs having varying degrees of complexity and performance, and being suitable for use in conjunction with computers having memory capacities ranging from 4K octets to more than 150K octets. A program written by Van de Geijn (The Hague, Holland) is presented. The program is used with the RAX operational system on a 360-40 IBM computer. The advantages and disadvantages of daily shared time applications are enumerated. (FR)

3621 PROBLEM OF RADIATION PROTECTION IN RADIOLOGICAL DIAGNOSIS. Barke, R.; Gursky, S. (Karl-Marx Univ., Leipzig). Radiol. Diagn.; 13: No. 3, 417-425(1972). (In German).

The problems of radiation protection are first of all to be considered from population-genetic aspects. With it radiation protection of the patients in radiological diagnosis becomes more and more interesting. A survey on the influencing factors of radiation protection shows that technical parameters as to FSD, field size, location of the field margin to the gonads, exposure time of fluoroscopy and so on indeed represent important characteristics; the knowledge, however, of the theoretical principles of radiobiology, radiation physics, and radiological technology can result in the reasonable and effective use of all means. From this only the demand can be derived to limit the circle of users of x rays for diagnostical purposes to the radiological specialist in future. (auth)

3622 FUNDAMENTAL AND PRACTICAL ASPECTS OF THE APPLICATION OF FAST NEUTRONS IN CLINICAL RADIOTHERAPY. Barendsen, G. W.; Broerse, J. J. (Radiobiological Inst. TNO). pp 453-460 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

A review is given of the results and plans discussed during the Second Meeting on Fundamental and Practical Aspects of the Application of Fast Neutrons in Clinical Radiotherapy, held in The Hague, The Netherlands, from 3 to 5 October 1973 and organized by the Radiobiological Institute TNO, Rijswijk. Topics discussed include the collimation of neutron beams, neutron depth-dose characteristics, neutron dosimetry, RBE values of fast neutrons for effects on normal tissues, and a review of clinical results of fast neutron therapy for patients with neoplasms. (CH)

3623 EFFECTS ON LYMPHOCYTES IN VITRO OF PLASMA FROM IRRADIATED PATIENTS. Stevenson, A. C.; Wiernik, G. (Churchill Hospital, Oxford). Radiat. Res.; 58: No. 2, 277-285 (May 1974).

The plasma of two patients who had had therapeutic irradiation for carcinoma of bronchus failed to induce detectable chromosome damage in the lymphocytes of donors or of their own lymphocytes collected before radiation therapy. (auth)

3624 EXTREME SENSITIVITY OF HUMAN CELLS TO IONIZING RADIATION FOR A FORM OF HEREDITARY DISEASE: XERODERMA PIGMENTOSUM. A Study of Single Strand Breaks of DNA and Chromosome Aberrations. Mikhel'son, V. M.; Aikazyan, E. V.; Genter, E. I.; Pleekach, N. M. (Inst. of Cytology, Leningrad). Tsitologiya; 16: No. 2, 203-210(Feb 1974). (In Russian).

A form of Xeroderma pigmentosum with extreme sensitivity to ionizing radiation was discovered. Lymphocytes of peripheral blood of the patient show a higher, than in normal lymphocytes, frequency of radio-induced chromosome aberrations and the absence of rejoining of gamma-induced single strand breaks of DNA. Caffeine, which inhibits DNA repair in normal lymphocytes, produces no effect on cells from patients with such a form of Xeroderma pigmentosum. Replicative synthesis of DNA in the cells of these patients is slowed down without irradiation. The discovered form of Xeroderma pigmentosum differs from the form with unchanged DNA sensitivity to ionizing radiation investigated recently (Cleaver, 1969; Kleijer et al., 1970). (auth)

Vertebrates

Refer also to abstracts 3174, 3486, 3503–3506, 3713, and 5772.

3625 (AD-763352) THERAPY OF POSTIRRADIATION MARROW HYPOPLASIA WITH BLOOD COMPONENTS AND ANTIBIOTICS. Nutter, J. E.; Graw, R. G. Jr.; Baum, S. J. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Mar 1973. 18p. (AFRRI-SR-73-5). NTIS $3.00.

Beagles exposed to 350 rads of bilateral ^{60}Co gamma radiation without subsequent supportive treatment died with an average survival time of 14 days and with the expected signs of the hematopoietic syndrome: leukopenia, fever and bacteremia. Neither the administration of prophylactic antibiotics (sodium ampicillin and gentamicin sulfate) alone nor the transfusion of irradiated erythrocytes and platelets altered the mortality although the antibiotic regimen resulted in a small but significant mean prolongation of life to 18 days. When erythrocyte and platelet transfusions were administered in combination with the parenteral antibiotic regimen during the period of profound leukopenia, eight of nine treated animals survived. This combined regimen allowed autochthonous recovery of narrow function, observed 18 to 28 days postirradiation. Once myelogenous recovery had begun, the antibiotics were discontinued. Erythrocyte and platelet transfusions could usually be discontinued during the 4th week postirradiation. This simple therapeutic regimen resulted in a greater survival rate for beagles following uniformly lethal doses of irradiation than has been reported previously. (auth)

3626 (AD-768921-9-GA) BARORECEPTOR REFLEX RESPONSE TO PHENYLEPHRINE AND CAROTID OCCLUSION IN MONKEYS RECEIVING 1000 RADS COBALT-60. Bruner, A.; Neely, A. W.; Henderson, E. A.; Weiss, G. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. (USA)). 10 Aug 1973. Contract DASA01-70-C-0059. 25p. (DNA-3161-T). NTIS $2.75.

Nine conscious monkeys received phenylephrine and carotid occlusion test of baroreflex function before and after 1000 rads cobalt-60 exposure (dose rate = 170 rads/min.). During the early postradiation minutes, concomitantly with hypotension and tachycardia, both baroreflex tests revealed depressed sensitivity (diminished blood pressure and heart rate changes). After 8 to 15 min postradiation, the phenylephrine, but not the occlusion test demonstrated a reversal to significant baroreceptor hypersensitivity that persisted 24 hrs or more. No failure of the baroreflex mechanisms was suggested. (auth)

3627 (AD-769658) EFFECTS OF MIXED GAMMA–NEUTRON RADIATION ON THE ACTIVITY OF BRAIN ENZYMES INVOLVED IN NEUROTRANSMITTER METABOLISM. Catravas, G. N.; McHale, C. G. Oct 1973. 17p. (AFRRI-SR-73-17). NTIS $2.75.

Sprague-Dawley adult male rats were exposed to incapacitating doses (20,000 rads) of mixed gamma-neutron radiation in a single pulse from the AFRRI-TRIGA reactor. The activities of the enzymes choline acetyl transferase, acetylcholinesterase, monoamine oxidase, and RNA polymerase were determined in the cerebral cortex, cerebellum, and hippocampus. It was found that as early as four min after irradiation of the animal the activity of monoamine oxidase was markedly decreased in all three brain

areas investigated. Choline acetyl transferase and RNA polymerase activities were also decreased but to a lesser extent. No appreciable changes in the activity of acetylcholinesterase were observed. (auth)

3628 (AD-770106) ALTERED GAMMA-AMINOBUTYRIC ACID METABOLISM EARLY IN THE POSTIRRADIATION RESPONSE OF THE RAT. Chaput, R. L.; Zeman, G. H. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Sep 1973. 15p. (AFRRI-SR-73-16). NTIS $2.75.

The metabolism of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) was studied in rats subjected to 10,000 or 20,000 rads of pulsed mixed gamma-neutron radiation. Whole brain GABA levels were found to rise above control levels by 20 min following 10,000 rads and as early as one min following 20,000 rads. L-glutamic acid decarboxylase activity was also observed to rise as early as one min following either dose of radiation. The results are consistent with the hypothesis that GABA is involved in the etiology of the transient central nervous system disorders (apathy, disorientation, ataxia) observed in rats shortly after high doses of ionizing radiation. (auth)

3629 (BNL-18794) PRIMARY AND SECONDARY ANTIBODY RESPONSES RELATED TO RADIATION EXPOSURES. Stoner, R. D.; Hess, M. W.; Terres, G. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 32p. (CONF-740331-1). Dep. NTIS $4.75.

From interaction of radiation and host immune mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

Results are reported from studies on the effects of whole-body exposure to ionizing radiations on primary and secondary antibody responses. Primary emphasis is placed on the form of antigen (soluble, adsorbed, or complexed) used to elicit antibody responses in normal and irradiated mice. Radiation was delivered either by γ radiation, x radiation, or 2.2 BeV protons. The tetanus toxin-antitoxin system was used to measure antibody responses in the present experiments. (CH)

3630 (COO-1602-46) EFFECTS OF X-IRRADIATION ON STEROID BIOTRANSFORMATIONS BY TESTICULAR TISSUE. Progress Report, August 1, 1973–July 31, 1974. Ellis, L. C. (Utah State Univ., Logan (USA). Dept. of Biology). 1974. Contract AT(11-1)-1602. 14p. Dep. NTIS $4.00.

Adult male rats were irradiated with 450 R of whole-body x irradiation. Animals were sacrified 1 and 24 hours later. Monoamine oxidase (MAO) activity, endogenous levels of serotonin (5-HT), 5-HT synthesis, and the uptake of 5-HT-^{14}C by their testes at these two time intervals were ascertained. MAO activity was increased at both time intervals while endogenous 5-HT remained unchanged. The amount of 5-HT-^{14}C taken up by the testes was not significantly altered by irradiation, whereas the synthesis of 5-HT from tryptophan-^{14}C was diminished. 5-HT, melatonin, AET and Nordihydroquaretic acid were effective in inhibiting specific steps in androgen biotransformations, lipid peroxidation, and malenaldehyde formation. Intratesticular implants of silastic capsules containing C-AMP resulted in reductions of testicular weight, stability of lysosomes, and reduced contractility of the seminiferous tubules. Intratesticular injections of either C-AMP or caffeine diminished testicular weight, but they were not as effective as a combination of the two. (auth)

3631 EFFECT OF BONE MARROW AUTOTRANSPLANTATION ON THE POSTRADIATIONAL RESTORATION OF THE INTESTINE. Fedorovskii, L. L. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 77: No. 2, 28-31(Feb 1974). (In Russian).

A study was made of the effect of bone marrow autotransplantation on postirradiational restoration of the intestine in rats under conditions of their uneven irradiation—of the intestine in a dose of 1050 R, and of the rest of the body in a dose of 735 R—which caused death of 100% of the animals. It appeared that 40% of the irradiated animals with bone marrow autotransplantation survived for up to 30 days of the observation period. (auth)

3632 COMPARISON OF THE EFFECTS OF IRRADIATION AND SPLENECTOMY ON BABESIA RODHAINI INFECTION IN MICE. Irvin, A. D.; Omwoyo, P.; Ledger, M. A. (East African Veterinary Research Organization, Kabete, Kenya). Int. J. Parasitol.; 3: 773-781(Nov 1973).

Babesia rodhaini infection was compared in irradiated, splenectomized and control mice. Although irradiation reduced the weight of the spleen by as much as 95%, this reduction in size did not result in parasitaemia levels comparable to those seen in splenectomized mice, which were consistently higher. Parasitaemias were similar in irradiated and control mice, but the mean survival time in control mice was longer than that of irradiated or splenectomized mice, which were comparable. Splenectomy generally resulted in higher parasitaemias than those seen in non-splenectomized mice. Since B. rodhaini has a predeliction for invading reticulocytes, the apparent failure of irradiated mice to develop parasitaemias comparable to those of splenectomized mice may have been due to the selective destruction of these immature red cells by irradiation. (auth)

3633 EFFECTS OF X-RAY IRRADIATION OF THE HEAD REGION OF 8-DAY-OLD FEMALE RATS ON THEIR REPRODUCTIVE CAPACITY WHEN 10 TO 17 MONTHS OLD. Martinovitch, P. N.; Ivanisevic-Milovanovic, O. K.; Milicic, A. F.; Martinovic, J. V. (Boris Kidric Inst., Belgrade). Experientia; 30: No. 2, 182-183(15 Feb 1974).

Heads of 8-day old female rats were exposed to 600 to 800 R of x rays. When tested at the age of 4 months, 91% of the animals were capable of reproducing. When the reproductive capacity was tested at the age of 10 to 17 months, approximately half of the irradiated rats did not become pregnant. Among those that did produce offspring, they did not differ from controls with respect to litter size and number of resorptions. (HLW)

3634 RADIOSENSITIVITY OF THE RAINBOW TROUT (SALMO GAIRDNERI RICH.) DURING EMBRYONAL AND LARVAL DEVELOPMENT. Buehringer, H. (Bundesforschungsanstalt fuer Fischerei, Hamburg). Arch. Fischereiwiss.; 24: No. 1/3, 51-63 (Aug 1973). (In German).

Fertilized eggs of the rainbow trout, at various stages of development, were irradiated once with a dose of 44 to 2,500 R of x-rays. The same doses, at various times, were also applied during larval development and juvenile stages. This showed that the sensitivity to radiation decreased, with the increasing age of the embryos, over the larval age to the juvenile stage. During this development period, however, particularly sensitive stages could be recognized. The characteristics of the damage are shown and described. Histological sections from the eyes of damaged trout give information of their optical ability and reveal, at the same time whether the damage can be reversed. (auth)

3635 IMPACT OF PRENATALLY ADMINISTERED RADIOPHOSPHORUS (P-32) ON THE POSTNATAL DEVELOPMENT OF SPLEEN AND THYMUS IN SWISS ALBINO MICE. Kumar, A.; Srivastava, P. N. (Univ. of Rajasthan, Jaipur, India). Arch. Biol. (Liege); 84: No. 3, 443-454(1973).

Ionizing radiations have been shown repeatedly to produce very marked effects on mammalian embryos and fetus in terms of lethality and production of abnormalities. Radiophosphorus (^{32}P) was intramuscularly injected to pregnant females on the third, seventh, eleventh, and nineteenth day of gestation period. The dose rate was 1.0 μCi/g body weight. The spleen and thymus were studied for the histopathological changes at 0 day, 3 days, and 42 days after parturition. There is more or less complete resorption of embryos in the females injected on third and seventh day of gestation. The changes in the spleen and thymus are more pronounced in the offspring of females injected on eleventh day of gestation. (auth)

3636 ELECTRON MICROSCOPIC STUDIES OF EXPERIMENTAL RADIATION PNEUMONITIS. Changes of Alveolar Epithelial Cells and Deformation of Alveolar Structures. Ohishi, T. (Keio Univ., Tokyo). Keio Igaku; 51: No. 1, 45-60(Jan 1974). (In Japanese).

The structural changes of the rat alveoli were observed by electron microscopy throughout the course of radiation pneumonitis and the subsequent diffuse fibrosis. In early stage, severe intracytoplasmic edema of the type I epithelial cells caused desquamation and erosion of the alveolar surfaces. These eroded surfaces were shortened by shrinkage and/or adhesion of the alveolar septa, and often covered by the immature epithelial cells. Mitosis of the type II cells was occasionally observed. Eight weeks after the irradiation, numerous macrophages and bizarre type II epithelial cells were noticed in the alveolar spaces. In this stage, fine collagen fibrils emerged around the hypertrophied septal cells proliferating in edematous alveolar walls. Four months later, diffusely fibrosed septa were covered by the flat epithelial cells, some of which were discharging the lamellar bodies. The disturbance of ordinary regeneration of the damaged epithelial cells would result in adhesion of the eroded alveolar surface and their shrinkage leaving severe deformation of the alveolar architecture. (auth)

3637 CYTOFLUOROMETRIC INVESTIGATION OF DNA AND DNP OF CELL NUCLEI OF THE ADRENAL CORTEX UNDER THE EFFECTS OF IONIZING RADIATION. Khamidov, D. Kh.; Khakimov, P. A.; Mamataliev, U. (Inst. of Biochemistry, Tashkent). Uzb. Biol. Zh.; No. 6, 3-6(1973). (In Russian).

The effect of γ radiation on the variation of DNA and DNP in cell nuclei of the adrenal cortex is studied by cytofluorometric methods. It is shown that at small irradiation doses the quantity of DNA is increased. High doses cause a decrease in the quan-

tity of DNA and of the intensity of the secondary fluorescence (DNP) of the cell nuclei. Cells of the reticulated and cluster zones are more strongly affected than cells of the globular zone. (tr-auth)

3638 TUMOR RADIOSENSITIVITY IN MICE. Urano, M. (National Inst. of Radiological Sciences, Chiba, Japan). 8: No. 1, 12-26(Mar 1973). (In Japanese).

The tumor radiosensitivity was examined by measuring TD_{50} (the number of tumor cells to make tumor transplant in 50% mice) and TCD_{50} (50% tumor controle dose, radiation dose to make 50% of transplanted tumors cure). Carcinoma of the breast in C_3H/He mice was used. Various doses were irradiated to the floating solution of these single cells under the hypoxic condition, and TD_{50} of each dose was measured. As TCD_{50} depended on the numbers of tumor cells, TCD_{50} of various sizes of tumors was obtained under the hypoxic condition. The cell numbers were calculated from the removed nuclei. Theoretical value of TCD_{50} after irradiating to that tumor including M cells was obtained from the recovery rate on the assumption that test tumor recurrence appeared where only one tumor cell remained, and that each tumor cell reacted independently to radiation. There was a difference ranged from 200 to 600 between the number of cells included in the irradiated tumor with TCD_{50} and its theoretical value. Therefore, even if 200 to 600 cells remained, 50% of tumors were considered to be cured and 50% recurrence. The proliferation of tumor occurred if there were about 500 remained tumor cells, as much as Revesy effect that TCD decreased when the cells affected by lethally irradiated cells were mixed with the remaining tumor cells, the proliferation of tumor occurred if there were about 500 remaining tumor cells. In addition, when irradiated tumor with TCD_{50} regrew, the proliferation was suggested to be delayed from the relationship between the tumor regrowth time and radiation dose. From these results, the variation of division probability in the case that the reproliferation of tumor cells began to occur was discussed. (JA)

3639 ELECTROENCEPHALOGRAPHIC RESPONSES TO 2500 RADS OF WHOLE-BODY GAMMA-NEUTRON RADIATION IN THE MONKEY MACACA MULATTA. McFarland, W. L.; Levin, S. G. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Radiat. Res.; 58: No. 1, 60-73(Apr 1974).

Monkeys were trained on a behavioral task and instrumented with chronic EEG recording electrodes and systemic arterial catheters for blood pressure measurement. They were then exposed to a 2500-rad pulse of mixed gamma–neutron radiation. Spectral analysis of the cortical electroencephalogram revealed changes in both frequency content and amplitude of the EEG related to periods of behavioral incapacitation. Simultaneous measurements of systemic blood pressure did not show any close relationships with EEG or behavioral changes. (auth)

3640 DAMAGES IN THE MICROSOMAL DRUG METABOLIZING ENZYME SYSTEM AFTER PARTIAL X IRRADIATION OF RAT LIVER. Yukawa, O.; Nakazawa, T. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 58: No. 1, 101-110(Apr 1974).

Activity of hexobarbital hydroxylation in liver microsomes of adult male rats receiving 750 R of x ray to the liver region decreased rapidly and reached a minimum on the fifth day after x irradiation. The values of apparent K_m and V_{max} changed markedly after x irradiation. The activities of NADPH oxidation and of NADPH cytochrome c reductase and the content of cytochrome P-450 also decreased considerably after x irradiation, though oxygen consumption was rather high. For the cytochrome P-450 spectral change induced by hexobarbital, the magnitude per unit of cytochrome P-450 decreased and the K_s value was altered significantly after x irradiation. Activities of microsomal phosphatases changed differently from hexobarbital hydroxylation after x irradiation. These results were discussed with regard to the mechanism of the effect of x irradiation on the drug metabolizing enzyme system in liver microsomal membranes. (auth)

3641 EARLY UNILATERAL THYMIC LYMPHOMA IN A POSTIRRADIATED WHITE-FOOTED MOUSE. Cosgrove, G. E.; Digregorio, D.; Dunaway, P. B. (Oak Ridge National Lab., TN). J. Wildlife Dis.; 10: 32-33(Jan 1974).

An early unilateral thymic lymphoma was found in one of 12 white-footed mice, Peromyscus leucopus, 7 months after 950 rads of whole-body irradiation. (auth)

3642 BIOLOGICHESKOE DEISTVIE DLINNOVOLNOVOGO RENTGENOVSKOGO IZLUCHENIYA. (Biological Effects of Long-Wave X Radiation). Liberman, A. N. Moscow; Atomizdat (1973). 156p.

The radiation genetic and clinical physiological characteristics of the operating conditions and health physics aspects developed at different installations generating long-waved x radiation are described. The results of current experiments and literature data on single and fractionated effects of this type of radiation on the organism and the determination of its relative biological effect by a series of clinical morphological, hematological, immunological, and biochemical indicators are reported. Questions on the basis of permissible levels of long-waved x-radiation of man are examined. Methods for the dosimetric control during work with sources of long-wave x radiation are discussed. Recommendations on radiation safety are given. (tr-auth)

3643 EFFECT OF DIFFERENT DOSES OF X IRRADIATION ON DYNAMICS OF CONDITIONED REFLEX ACTIVITY AND CONSOLIDATION OF DIFFERENTIATED INHIBITION IN RATS OF MIDDLE AGE. Kharchenko, P. D.; Elmuratov, S.; Chaichenko, G. M. (Kiev State Univ.). Fiziol. Zh., Akad. Nauk Ukr. RSR; 20: No. 2, 147-153(1974). (In Ukrainian).

Experiments were performed on 7 to 8 months old white rat males. After total x irradiation in doses of 500, 600, and 700 R, phasic changes were observed in the conditioned reflex activity: phase I, an inhibition of the motor activity (1st to 2nd day); phase II, an increase in the activity (3rd to 5th day); and after the period of relative stabilization there appeared phase III, a short-lasting increase in the reflex and intersignal reflex values. Irradiation in doses of 600 and 700 R causes a disappearing of differentiation. This process was also of 3-phase character: phase I was observed on the 2nd to 4th day, phase II—on the 8th to 9th day and phase III—on the 15th to 16th day after irradiation. Ionizing radiation at 500, 600, and 700 R affected the strength of the basic nervous processes, inhibition predominantly. (auth)

3644 EFFECT OF SOME ERYTHROPOIESIS STIMULATORS ON REGENERATION OF THE ERYTHROCYTE SYSTEM IN RATS FOLLOWING WHOLE-BODY IRRADIATION WITH SUBLETHAL DOSE OF X RAYS. Paprocka-Slonka, E.; Kuratowska, Z. (Instytutu Baden Jadrowych, Warsaw). Acta Haematol. Pol.; 4: No. 3, 247-253(1973). (In Polish).

Wistar rats were used for study of the effects of known stimulators of erythropoiesis on radiation-induced changes following one dose of 500 R of x rays to the whole body. It was found that exogenous erythropoietin administered in single and repeated doses had no effect on the characteristics of radiation-induced disturbances of erythropoiesis without respect to the time of its administration in relation to the moment of exposure. Cobalt chloride given before or after the exposure had similarly no effect on radiation-induced inhibition of erythropoiesis in rats. Testosterone increased plasma erythropoietin activity if it was given before or on the 5th, 6th, and 7th days after exposure. However, stimulation of erythropoiesis (determined by incorporation of radioactive iron into red blood cells) was observed only if testosterone was injected on the 5th, 6th, and 7th day after exposure. This seems to suggest that this hormone has a direct action on hemopoietic cells. (auth)

3645 STUDY OF THE ACTIVITY OF LYSOSOMAL ENZYMES IN THE RAT LIVER TISSUE DURING IRRADIATION. Agabekova, I. I. Tr. Tadzh. Gos. Med. Inst.; 97: 21-26(1973). (In Russian).

Results are reported of the study of the activity of acid phosphatase and β-glucuronidase in the liver tissue of rats at various periods after general x-ray irradiation. The authors conclude that even though the enzyme activity in blood serum reflects in general the pathological process developing in the tissue after radiation damage, the value of its determination drops because of a series of factors (degree of the destruction of lysozymes, the intensity of the washout into the blood). (Ref. Zh.)

3646 EFFECT OF HIGH DOSE X IRRADIATION ON THE GLYCOLIPIDS CONTENT IN THE BRAIN OF WHITE RATS. Norman, T. N. Vestn. Beloruss. Gos. Univ., Ser. 2; No. 2, 24-27 (1973). (In Russian).

Quantitative levels of general fractions of gangliosides and cerebrosides in the white rat brain were determined after a single general x-ray irradiation at a 700 R dose. A wave-like type of glycolipid changes in the brain of irradiated animals was demonstrated. In the initial phase of radiation damage the ganglioside level drops to 20%; at the peak of radiation sickness the level of the gangliosides drops drastically. Even after 30 days following the exposure to ionizing radiation the content of gangliosides is not reestablished. The quantity of cerebrosides in the early stage after exposure (1 hr, 1 day, 3, and 7 days) is lower than in control animals, however, after 15 days it exceeds the standard by 27.3%. After 30 days the level of cerebrosides in the brain of irradiated rats returns to the control level. (Ref. Zh.)

3647 LEVEL OF SIALIC ACID EXCHANGE IN LIVER AND IN MIACORD OF RATS SUBJECTED TO X IRRADIATION. Malashevich, Ya. Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 4, 73-76(1973). (In Russian).

The content of sialic acids in the liver and heart muscle of Wistar rats subjected to 10 and 20 week fractional irradiation at a total dose of 50 roentgen was investigated. In some periods of postirradiation effect, deviations were observed from the controls in the content of sialic acids, which had no pathological meaning. Possible reasons for the changes in the quantity of sialic acids in the irradiated organisms are indicated. The type of disturbances and possible role of liver in their regeneration are discussed. (Ref. Zh.)

3648 DISTRIBUTION OF SMALLPOX VACCINE VIRUS IN THE BODIES OF IRRADIATED AND NONIRRADIATED RABBITS. Vartevanyan, Zh. Ts. (Ministry of Public Health, Erevan). Zh. Eksp. Klin. Med.; 12: No. 1, 35-39(1972). (In Russian).

The time of appearance, duration of the condition, and degree of dissemination of smallpox virus after intracutaneous immunization in irradiated (700 R) and nonirradiated rabbits were studied. Viremia appeared earlier, was detected with greater frequency, and lasted longer in the irradiated rabbits. Also, the virus penetrated earlier and had longer lasting effects in the reticuloendothelial organs and liver of the irradiated rabbits. (tr-auth)

3649 MECHANISM OF THE RADIOPROTECTIVE EFFECT OF NITROGEN-CONTAINING HETEROCYCLIC COMPOUNDS. Kulyabko, P. N.; Dubenko, R. G.; Konysheva, V. D. Fiziol. Aktiv. Veshchestva; No. 4, 87-89(1972). (In Russian).

The effect of derivatives of 1-aryltetrazoline-5-thions and 1-aryltriazoline-2,5-dithions (a total of 15 compounds) on O_2 tension in the spleen, liver, and muscles of rats was studied. The tetrazoline aryl derivatives had no effect (or they increased) O_2 tension in the tissues, whereas the triazoline-2,5-dithion derivatives decreased it; the peak was reached in the first 20 to 40 minutes. 1-phenyltriazoline-2,5-dithion had the greatest effect in this respect. It was concluded that the mechanism of the radioprotective action of the triazoline-2,5-dithion derivatives (but not the tetrazoline-5-thion derivatives) is based on an "oxygen effect." (JPRS)

3650 CHANGES IN THE PHASE STRUCTURE OF THE CARDIAC CYCLE DURING CONTINUOUS WHOLE-BODY IRRADIATION OF RABBITS. Dzhandzhgava, M. M.; Nadareyshvili, K. Sh.; Sharashenidze, N. B. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; No. 1, 193-195(1973). (In Russian).

The first signs of approaching radiation shock appeared in rabbits within 30 to 35 min of continuous whole-body irradiation at 10 to 16 krad, although blood pressure remained fairly high. The period of contraction increased while the duration of ejection decreased. Blumberger's mechanical coefficient also decreased and Hegglin's interval became sharply negative. Thus, despite the fact that blood pressure, pulse, and respiratory rate at this time had not changed significantly, there were clear indications of the phase syndrome of hypodynamia of the left ventricle. After exposure to doses ranging from 18 to 25 krad, the animals' blood pressure began to fall quickly, the pulse and respiration slowed, and the symptoms characteristic of radiation shock appeared. The animals died within 20 to 30 min in a state of deep shock. The phase structure of the cardial cycle was severely disrupted. (JPRS)

3651 INFLUENCE OF SELENIUM ON THE IMMUNOLOGICAL FEATURES OF BLOOD PLASMA OF IRRADIATED ANIMALS. Abdullaev, G. B.; Teplyakova, G. V.; Gasanov, G. G.; Mekhtiev, M. A.; Alieva, N. V.; Dzhamalov, D. B. (Inst. of Physics, Buka). Dokl. Akad. Nauk Azerb. SSR; 29: No. 10, 35-38(1973). (In Russian).

Immunological response of the organism on the irradiation was studied with the use of sodium selenite as a chemical protector. Experimental results showed that the introduction of the sodium selenite before the roentgen irradiation increase the number of the surviving animals, decrease the irradiation affection, and increase the amount of the negative reactions of the blood plasma with lysate of erythrocytes (Hoigne reaction). This reaction shows the immunological changes in blood plasma and may have a prognostic significance. (auth)

3652 TREATMENT OF METASTATIC OSTEOSARCOMA BY CYCLOPHOSPHAMIDE AND RADIOTHERAPY. Shaeffer, J.; El-Mahdi, A. M.; Constable, W. C. (Univ. of Virginia, Charlottesville). Radiology; 111: No. 2, 467-469(May 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Osteosarcoma cells were injected intravenously into isologous C3H/He mice to produce pulmonary colonies or metastases. Either cyclophosphamide in doses up to 150 mg/kg × 3 or thoracic irradiation in doses up to 2100 rads was given one day postinjection when pulmonary colonies were occult or 14 days postinjection when they were manifest. The number of colonies was scored in treated and sham-treated control animals 28 days postinjection. (auth)

3653 SUCCESSFUL RADIATION PROTECTION OF THE NORMAL INTESTINAL TRACT IN THE DOG. Steckel, R. J.; Snow, H. D.; Collins, J. D.; Barenfus, M.; Patin, T. (Univ. of California, Los Angeles). Radiology; 111: No. 2, 451-455(May 1974).

Successful experimental radiation protection of the small bowel and the proximal colon has been achieved in controlled animal studies, utilizing a selective superior mesenteric artery infusion of vasopressin during abdominal irradiation. The success of this technique contrasts with the nonreliability of a combination of propranolol and epinephrine infused by the same route. The differences in efficacy of these two categories of vasoconstrictors may be related to differences in the locus of activity of vasopressin and propranolol-epinephrine in the mesenteric arterial tree. (auth)

3654 LUCHEVOYE PORASHENIYE MLEKOPTIAYUSHCHIKH I STATISTICHESKOYE MODELIROVANIYE. (Radiation Sickness in Mammals and Statistical Modeling). Akoyev, I. G.; Maksimov, G. K.; Malyshev, V. M. Moscow; Atomizdat (1972). 99p.

Statistical models of radiation sickness in mammals are discussed in relation to their use in predicting the degree of injury resulting from exposure to various radiation doses and dose rates and the influence of various modifying factors on the severity of the symptoms. (CH)

3655 LUCHEVOYE PORAZHENIYE MLEKOPITAYUSHCHIKH I STATISTICHESKOYE MODELIROVANIYE. (Dose Relations of Radiation Sickness Under the Effect of Protective Factors). Akoyev, I. G. Moscow; Atomizdat (1972). 99p.

The etiology of radiation sickness in mammals is discussed in relation to radiation dose response relationships, response modifying factors, and post-irradiation recovery with respect to the resistance of the organisms to repeated irradiation. The validity of statistical models of the development of pathological processes with time following irradiation for the prediction of recovery or lethal outcome is discussed. (CH)

3656 GROWTH PATTERNS OF FETAL HEMOPOIESIS AND THE REGULATION OF FETAL ERYTHROPOIESIS. Kubanek, B. (Univ. Ulm, Ger.). Haematol. Bluttransfus.; 10: 13-25(1972).

It appears from these studies: that red cell production in fetal life is in fact under control of erythropoietin; that there is a difference between fetal and adult hemopoietic cells, which appears to be mainly due to different growth patterns. The further study of this problem should provide valuable information for our understanding the regulation of stem-cell homeostasis. The erythropoietin sensitive stem cell compartment develops independently of the availability of erythropoietin, but the size of the compartment may increase with the increased demand caused through a stimulation by erythropoietin. (auth)

3657 MOVEMENT OF LABELED BASAL CELLS IN THE MOUSE TONGUE AFTER RADIATION INJURY. Glass, R. T.; Goepp, R. A. (Univ. of Chicago). Radiat. Res.; 58: No. 2, 230-238(May 1974).

Male C57Bl mice were used to study the movement of labeled cells into the Malpighian layers after radiation injury. The relationship between mitotic cells in the basal layer and the cells which had moved into the maturation layers was also examined. In the irradiated, chemically protected mouse tongues, the labeled cells in the Malpighian layers were in large groups on the fifth postirradiation day. These groups occurred between clusters of basal cells in mitosis. Consistently, there were no clusters of basal cells in mitosis nor groups of labeled cells in the maturation layers in the irradiated, nonprotected mouse tongues. (auth)

3658 ULTRASTRUCTURAL RADIATION INJURY OF RAT PAROTID GLAND: A HISTOPATHOLOGIC DOSE-RESPONSE STUDY. Sodicoff, M.; Pratt, N. E.; Sholley, M. M. (Temple Univ., Philadelphia). Radiat. Res.; 58: No. 2, 196-208(May 1974).

Radiation damage to rat parotid acinar cells was evaluated by electron microscopy using exposures of 400, 800, 1600, and 6400 R. Evidence of intracellular damage was observed at all exposures by the presence of focal cytoplasmic lesions involving all of the organelles. The extent of the damage varied with dose, 400 R resulted in very mild injury while 6400 R caused extensive necrosis (1 to 4 days after irradiation) with signs of recovery in evidence by Day 6. In addition, at the lower doses, 400 and 800 R, the Golgi complex was found to be hypertrophied although at the higher doses, 1600 and 6400 R, this did not occur. Therefore, it was determined that x-irradiation results in histopathologic changes to the parotid gland at a relatively low dose and the extent of the damage varies directly with dose. (auth)

3659 RELEASE OF RIBOSOMES FROM ENDOPLASMIC RETICULUM (E.R.) OF X-IRRADIATED LIVERS. Mukerjee, H.; Goldfeder, A. (New York Univ., NY). Radiat. Res.; 58: No. 2, 253-261(May 1974).

The effects of whole-body x-irradiation on mouse liver cells were studied. At 1 hr after 2000 rad, the concentration of free ribosomes increased by 15 to 20% in post-mitochondrial fractions and by about 30% in post nuclear fractions. The release of ribosomes was accompanied by 47% loss of Ca^{2+} and 17% loss of Mg^{2+} in liver microsomal fractions. The activity of glucose-6-phosphatase in endoplasmic reticulum (E.R.) membranes of liver also decreased by 30% after 2000 rad. The loss of Ca^{2+} and Mg^{2+} and the decrease in the activity of the membrane bound glucose-6-phosphatase suggest a possible change in composition and structure of E.R. membranes after x-irradiation. (auth)

3660 SPATIAL RELATIONSHIP OF BASAL CELLS IN THE MOUSE TONGUE AFTER RADIATION INJURY. Glass, R. T.; Goepp, R. A. (Univ. of Chicago). Radiat. Res.; 58: No. 2, 219-229(May 1974).

Male C57Bl mice were used to study the spatial relationship of basal cells in DNA synthesis and mitosis in the epithelium of the anterior dorsum of the mouse tongue after radiation injury. The distribution of basal cells in DNA synthesis and mitosis was nonrandom on the third through the sixth postirradiation day in mouse tongues which had received topical chemical protection prior to irradiation. In irradiated, nonprotected mouse tongues, the distribution of basal cells in DNA synthesis was random on all 9 postirradiation days while in nonirradiated, control mouse tongues, the distribution was equivocal. The nonrandom distribution of basal cells in DNA synthesis and division was related to the recovery of the epithelium after radiation injury. (auth)

3661 EFFECT OF AGE OF THE ACUTE LETHAL RESPONSE OF THE BEAGLE TO COBALT-60 GAMMA RADIATION. Garner, R. J.; Phemister, R. D.; Angleton, G. M.; Lee, A. C.; Thomassen, R. W. (Colorado State Univ., Fort Collins). Radiat. Res.; 58: No. 2, 190-195(May 1974).

Mortality to 60 days following exposure to ^{60}Co γ-radiation (bilateral, whole-body; 10 min exposure time) was studied in 387 male and 273 female purebred beagles exposed at various ages from the late fetal stage to adulthood. $LD_{50/60}$ values in males and females respectively were estimated to be: 55 day fetus, 324 and 295 R; 2 days post partum, 385 and 408 R; 15 days, 378 and 355 R; 35 days, 322 and 278 R; 63 days, 287 and 270 R; 70 days, 290 and 272 R; and in 1.5-2 yr-old males and 4-6 yr-old females respectively, 316 and 278 R (midline, in-air exposure). Except in animals irradiated prenatally, most deaths occurred 15 to 20 days post exposure. Bone marrow damage appeared to predominate. (auth)

3662 HAEMATOLOGICAL AND PATHOLOGICAL INVESTIGATIONS ON HETEROLOGOUS BONE MARROW TRANSPLANT IN IRRADIATED RABBITS. Polese, E.; Rossi Torelli, M. (Centro Applicazioni Militari Energi Nucleare, S. Piero a Grado, Italy). Minerva Med.; 61: No. 77, 4166-4170(1970). (In Italian).

Ten male adult rabbits irradiated with 1000 R of 220 Kvp x rays were inoculated 24 hours later with human bone marrow cells. Secondary disease developed in all animals, nine of which died within 48 hours; the only survivor died 14 months later with acute enteritis. The hematological and pathological study carried out on the animals showed that the cause of death in the nine animals was graft versus host rejection combined with acute radiation syndrome; the survival of the tenth animal may have been due to the success of the therapy employed in a less sensitive individual. (INIS)

3663 COMPARATIVE HEMATOLOGICAL EFFECTS OF COBALT GAMMA RAYS AND THE RADIATION EMITTED IN A CRITICALITY EXPERIMENT (THE CRAC INSTALLATION). Malarbet, J. L.; Le Go, R.; Prudhomme, J.; Genest, L. (CEN, Fontenay-aux-Roses, France). pp 283-298 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974). (In French).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The evolution of the main blood parameters was studied in CFE rats exposed to flashes of mixed γ-neutron radiation produced during uncontrolled criticality experiments in a liquid medium. Aluminium cylinders, each containing a rat, were suspended around the criticality reaction tank in the meshes of a large vertically hung net in such a way that the zone occupied by the cylinders was as nearly isodose as possible. Gamma dosimeters and neutron dosimeters (SNACs) were attached to the net along with the aluminium cylinders. Other rats were studied after homogeneous whole-body exposure to ^{60}Co γ radiation. Hematological examinations (red cell count, reticulocyte count, and white cell count) were carried out over a period of two months following irradiation, initially at intervals of some hours and later of some days. The results were treated statistically and the evolution of the parameters visualized by means of a component analysis. The doses of mixed radiation and pure γ radiation administered gave a similar evolution of blood parameters, but there was a clear difference in biological effectiveness between the action of the pure γ rays and that of the mixed radiation. (auth)

3664 EFFECTS OF INTRACAVITARY IRRADIATION BY CALIFORNIUM-252. Sullivan, M. F.; Beamer, J. L.; Mahony, T. D. (Battelle Pacific Northwest Labs., Richland, WA). pp 299-310 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Twenty-five years ago Stone stated that the late effects from fast neutrons were proportionately more severe than the acute response when compared with expected results from exposure to ionizing radiation. Since that time improvements in neutron dosimetry and additional information on the effects of neutrons have resulted in renewed interest in the use of these radiations for cancer therapy. With the availability of encapsulated ^{252}Cf there is need for information on the response of normal tissues at risk during intracavitary exposure to a ^{252}Cf implant. Because of their anatomical characteristics, miniature swine were used in studies comparing the short- and long-term effects of intracervically implanted ^{226}Ra or ^{252}Cf. Capsules containing 50 mg Ra or 50 μg Cf were inserted in the cervix with a tandem applicator using an after-loading technique. In some animals thermoluminescent dosimeters were implanted in organs adjacent to the sources. The Ra pigs received a fractionated dose calculated as 7000 to 14,000 rads at a point 2 cm lateral to the source. The Cf pigs received between 2000 and 6000 rads. Some pigs were killed at weekly intervals to determine acute effects; others were killed at later intervals, or when moribund, for study of long-term effects. At two weeks post exposure acute damage from 10,500 rads exposure to ^{226}Ra was similar to that caused by 2800 rads from ^{252}Cf. Damage consisted of a well-defined ulcer on the anterior wall of the rectum adjacent to the source location. The ulcer did not heal and persisted into the late period as a chronic radiation ulcer. The urinary bladder, except at the high doses, did not show gross ulceration, but a diffuse erythema occurred in the trigonal or supratrigonal region of the bladder, with varying degrees of petechial hemorrhage. These changes indicate an acute RBE of slightly greater than six for both the rectum and urinary tract; indications are that the RBE for long-term effects will be larger. (auth)

3665 REGENERATION OF GASTRIC GLANDULAR EPITHELIUM IN ADULT MICE AFTER EXPOSURE TO 1-MeV FAST NEUTRONS. Davids, J. A. G. (Reactor Centrum Nederland, Petten). pp 311-324 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Severe destruction of the glandular epithelium of the stomach develops after whole-body irradiation of mice with fission fast neutrons of 1-MeV mean energy in the upper lethal and supralethal dose range. In the first week after exposure the cells decrease in number especially in the gastric pits. In the second week extensive necrosis of cells occurs in the fundic glands. Cellular proliferation starts in the isthmus region of the glands. The regeneration of the epithelium of the gastric pits proceeds quickly and at the end of the second week a new layer of surface epithelial cells has been formed. The regeneration of the epithelium of the fundic glands proceeds more slowly. First a continuous layer of mucous neck cells is formed during the third week. In the fourth week a layer of parietal cells grows between the basal membrane and the mucous neck cells and finally zymogenic cells differentiate in the bottom of the glands within six weeks after irradiation. The results show that even after a severe generalized destruction, the glandular epithelium of the stomach in the adult organism has preserved the potential of full regeneration. (auth)

3666 SURVIVAL OF SPERMATOGONIAL STEM CELLS IN THE MOUSE AFTER EXPOSURE TO 1.0-MeV FAST NEUTRONS. de Ruiter-Bootsma, A. L. (State Univ., Utrecht); Kramer, M. F.; de Rooij, D. G.; Davids, J. A. G. pp 325-334 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Spermatogonial stem cells are able to repopulate the testis by forming clones that elongate along the walls of the seminiferous tubules depleted of spermatogenetic cells as a result of an irradiation. The surviving number of stem cells after irradiation was estimated by determining the fraction of repopulated tubules in cross-sections of the testis 11 weeks after irradiation. This fraction, called the repopulation index, is assumed to be directly proportional to the number of surviving stem cells. Groups of mice were irradiated with different doses of 1-MeV fast neutrons, ranging from 200 to 410 rads. Within this dose range the dose-response curve has an exponential slope with a D_0 of 85 rads. This value indicates the rather low radiosensitivity of spermatogonial stem cells, compared with differentiated spermatogonia and stem cells of other tissues. Two other groups of mice received doses of 900 and 1200 rads of x rays to determine the RBE of the fast neutrons used. A RBE value of 4.4 was found. We also studied the response of spermatogonial stem cells to a dose of 350 rads of fast neutrons, divided into two fractions, using fractionation intervals varying between 0 to 48 hours. At all intervals repopulation indices were lower than in controls irradiated without fractionation. The radiosensitivity of the stem cells increases sharply between 4 and 8 hours after the first irradiation. Hence, in contrast to the behavior of stem cells in other tissues investigated, spermatogonial stem cells surviving an irradiation get into a state or phase of greater radiosensitivity. (auth)

3667 USE OF THE WOUND RESPONSE TO COMPARE RECOVERY OF NEUTRON OF X-IRRADIATED INTERMITOTIC (G_0) CELLS OF THE RAT LENS EPITHELIUM. Riley, E. F.; Austin, B. T.; Lindgren, A. L.; Miller, R. C. (Univ. of Iowa, Iowa City). pp 335-348 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

A small puncture wound in the central zone (anterior polar region) of rat lens epithelium caused most of the intermitotic (G_0) cells around the wound to enter the cell division cycle. A wave of ^{3}H-thymidine cell labeling (DNA synthesis) began about 14 h after wounding and mitosis began about 10 h later. Irradiation prior to wounding delayed and suppressed the response to wounding. A decreased ability to respond to wounding was utilized as an indicator of latent radiation damage and as a measure of residual damage during cellular recovery after a single dose of x rays (1000 rads, HVL = 1 mm Cu) or fission neutrons (200 rads). When cells were tested by wounding at 1 h after x irradiation, the wave of cell labeling was delayed 5 to 6 h and the amplitude of the wave was suppressed to about $\frac{1}{6}$ of the amplitude of the control wave. A comparable delay and suppression of the wound response was observed at 1 h after neutron irradiation. There was a gradual increase in the amplitude of the cell-labeling wave during the first 7 d after x irradiation, but there was no corresponding increase in the amplitude of the cell-labeling wave during the first week after neutron irradiation. Another criterion, the percentages of abnormal anaphase and telophase figures in responding cells, also suggested a slower recovery during the first week after neutron irradiation than during the first week after x irradiation. The percentages decreased from 73 to 57% during the first week after x irradiation and from 47 to 42% during the first week after neutron irradiation. By 30 days postirradiation the neutron irradiated cells had recovered as much as had the x irradiated cells. In each case the cells were able to respond without delay, but less than the control number were able to respond at any one time. (auth)

3668 RBE VALUES OF 400-MeV AND 14-MeV NEUTRONS USING VARIOUS BIOLOGICAL EFFECTS. Bianchi, M. (CERN, Geneva); Baarli, J.; Sullivan, A. H.; Di Paola, M.; Quintiliani, M. pp 349-357 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Experimental investigations of RBE values for a beam of 400-MeV neutrons using a few highly radiosensitive biological test systems have been carried out. These include: testes weight loss, survival of type-B spermatogonia and lens opacification in mice, and in addition 10 days growth of Vicia faba roots. Some of these test systems have also been used for similar studies with 14-MeV neutrons. In all investigations ^{60}Co γ rays and 220 to 250-kV x rays were used as reference radiations. The results obtained are presented and discussed in the light of possible effects from the nuclear processes involved when using the beam of 400-MeV neutrons. All studies, including those with the reference radiation, have been made with dose rates of 5 to 7 rad/h. The possible implication of the results obtained for radiation protection problems with high energy radiation is considered. (auth)

3669 LATE EFFECTS OF NEUTRON OR GAMMA IRRADIATION IN MICE. Ainsworth, E. J.; Fry, R. J. M.; Grahn, D.; Williamson, F. S.; Brennan, P. C.; Stearner, S. P.; Carrano, A. V.; Rust, J. H. (Argonne National Lab., IL). pp 359-379 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The experiments aim to provide data for the development of models of radiation morbidity and mortality so that late effects of low doses of neutron or γ radiation may be understood and predicted in terms of: the actuarial statistics of disease and death; cell injury and recovery; and tissue and organ injury, repair, and regulation. The late effects experiment in progress is designed to evaluate the additivity of small doses of neutron or γ radiation delivered at different intervals and dose rates over a period of 6 months. Total fractionated doses are 80 to 240 neutron rads and 855 or 1140 rads of γ radiation; a single dose series, conducted at 3 ages with mice of both sexes, will assist with estimation of protraction factors as well as age sensitivity to radioinduced life-shortening. The principal endpoints are death and tumor rates, but various cellular and physiological studies support the late effects experiment. Morphological and functional alterations of the microvasculature, susceptibility to upper respiratory infection, and alterations in the stem cell content of the femur have also been evaluated after single or fractionated doses of neutron or gamma radiation. Chromosomal aberrations in human leukocytes have been compared after a single dose of neutron or x radiation. Preliminary mortality results indicate that fractionation of the neutron dose of 240 rads produces greater life-shortening and higher tumor rates than does the same single dose. Fractionation of the γ dose of 855 rads results in a sparing effect on life-shortening and tumor rates and the protraction factor appears to be about 3. Instantaneous dose rate/fraction, dose/fraction, or number of fractions do not appear to influence the amount of life-shortening produced by neutron irradiation; effects of these variables on life-shortening produced by γ irradiation are not yet clear. The current estimate of RBE for life-shortening under conditions of one 45-min exposure per week for 24 weeks is approximately 11. (auth)

3670 NEUTRON-INDUCED MAMMARY NEOPLASMS. Vogel, H. H. Jr. (Univ. of Tennessee, Memphis). pp 381-389 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Three-month-old female Sprague–Dawley/ANL rats were exposed at the Health Physics Research Reactor (DOSAR), Oak Ridge National Laboratory, to a single whole-body dose of fission neutrons between 2.0 and 2.2 rads. 18/71 (25%) of these irradiated rats developed a mammary tumor within 450 days after exposure. During this same time only 6/101 unirradiated control rats showed any palpable spontaneous mammary tumors. These differences are highly significant ($p = <0.01$). The results from this neutron experiment were compared with similar exposures to low-LET x irradiation. Relative biological effectiveness for this tumor system appears to be approximately 50 at this low neutron dose. This is an extremely high value for any mammalian system tested to date, although recent evidence indicates that this mammary tumor system may not be unique in such high RBE values after low neutron doses. More work in radiobiology, especially at low doses, is needed before neutron radiation therapy is applied to man. (auth)

3671 GENETIC EFFECTS OF NEUTRONS IN MAMMALS AND THEIR IMPLICATIONS FOR RISK ASSESSMENT IN MAN. Searle, A. G. (Medical Research Council, Harwell, Eng.). pp 461-471 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Most work in the field of genetic effects of neutrons has been concerned with fast (usually fission) neutrons, with the mouse as experimental animal. Studies have concentrated on the germ-cells at greatest risk of radiation exposure, namely stem-cell spermatogonia and resting oocytes. Highest RBE values are found after chronic exposures, as expected. For fission neutron irradiation, these values are around 20 for the induction of dominant and recessive mutations and about 20 to 25 for the induction of translocations in spermatogonia. For acute exposure, corresponding figures are 6 and 4 respectively. A different picture emerges after irradiation of female mice. Although high RBE values are again

found with acute irradiation of maturing oocytes, mutation frequencies are so low after chronic irradiation, or acute irradiation of immature oocytes, that no RBE values can be calculated. There is good reason to believe that results for mouse spermatogonia will also roughly apply to man, but the great differences between mouse and human oocytes make such extrapolation much more dangerous in females. However, the genetic risk from neutrons is likely to be less in exposed females because of the considerable attenuation of the dose before the radiation reaches the ovaries. The RBE values and doubling doses for fast neutron irradiation of spermatogonia can be used to modify the current risk estimates for low-LET irradiation given in reports published by the United Nations and the U. S. National Academy of Sciences. Resultant values for some of the expected deleterious hereditary effects of one rad fission neutrons are quite high and fully justify the present protective measures. (auth)

3672 DETERMINATION OF THE $LD_{50/30}$ IN PANIRRADIATED INBRED RATS. Montecucchi, P.; Covi, A.; Botteghi, F. (Centro Applicazioni Militari Energi Nucleare, S. Piero a Grado, Italy). Minerva Med.; 61: No. 77, 4185-4190(1970). (In Italian).

Albino Wistar inbred rats were irradiated with 650/1000 R of 220 Kvp x rays. The $LD_{50/30}$ among them was found to be 848 R for the females and 851 R for the males. (INIS)

3673 FUNCTIONAL DECOMPENSATION OF LIVER CELL GENOME INJURED WITH MUTAGENS UNDER CONDITIONS OF PROLONGED INDUCTION. Akifiev, A. P.; Movsesyan, M. V. (Inst. of General Genetics, Moscow). Tsitol. Genet.; 7: No. 3, 258-260(1973). (In Russian).

A sharp inhibition was observed of the first mitotic cycle after hepatectomy under the effect of prolonged induction of rat liver cells with hydrocortisone after preliminary action with the polyfunctional alkylating agent dypine and with ionizing radiation. (auth)

3674 STEM CELL DYNAMICS IN FORMING OF SPLEEN COLONIES. Experimental Study of Hematopoiesis. Hirashima, K. (National Inst. of Radiological Sciences, Chiba, Japan). Saishin Igaku; 28: No. 9, 1720-1732(Sep 1973). (In Japanese).

Methods of spleen colony formation and hematopoietic disorders are described. The role of erythropoietin in proliferation and differentiation of erythrocytes was studied. Following x-irradiation of mice with 500 R the recovery effect of spleen colony-forming units was studied. The pathology of aplastic anemia was studied in relation to hematopoiesis. Hematopoietic disorders induced by antineoplastic agents and immunosuppressive agents were compared with those induced by cyclophosphamide and x irradiation. Studies on the effects of aging on hematopoiesis showed that colony-forming units in the bone marrow were constant up to 21 months of age but that those in the spleen decreased with age. Studies were also conducted on the induction of neoplasms by Friend virus in relation to leukemia. (HLW)

Invertebrates

Refer also to abstracts 3507 and 3508.

3675 (CONF-720486-, pp 49-56) DISINFESTATION OF STORED PRODUCTS BY GAMMA IRRADIATION. I. Defining Lethal Doses for the Red Flour Beetle, Tribolium Castaneum Herbst, and Saw-Toothed Grain Beetle, Oryzaephilus Surinamensis (Lin.). Rejesus, R. S.; Lapis, E. B. 1972.

From joint annual convention of the radioisotope and nuclear medicine meeting; Quezon City, Philippines (7 Apr 1972).

An investigation was made to assess the susceptibility of the eggs, larvae, pupae, and adults of Tribolium castaneum and Oryzaephilus surinamensis to gamma radiation. The eggs were the most susceptible followed by the larvae, pupae, and adults respectively. A dose of only 10 kR prevented the eggs of both species from emerging as adults. Higher doses were required to kill the other stages. Adults of both species irradiated with 15 kR died 28 days after treatment. This dose (15 kR) seems to be the effective level for all the developmental stages. The succeeding experiments will be primarily concerned with reproductive potential and sterility as effected by sublethal doses. These are deemed necessary as insects are found in stored commodities even after long periods of post-irradiation storage. (auth)

3676 SOME REGULARITIES IN OCCURRENCE OF THE MORPHOSE AGAMETIC GONADS AS THE RESULT OF UV IRRADIATION OF DROSOPHILA EMBRYOS. Levin, V. L.; Romashkina, T. B.; Shvartsman, P. Ya.; Shelomova, L. F. (Inst. of Cytology, Leningrad). Tsitologiya; 16: No. 2, 211-216(Feb 1974). (In Russian).

At different stages of development the posterior polar region of Drosophila embryos was uv-irradiated. Two indices were used to estimate the results, the embryons lethality and the occurrence of the morphose "Agametic gonads" in imago. The sensitivity to uv-light of the embryos themselves and of their determinants responsible for the development of gonocytes changes independently during embryogenesis. The survival rate was found to be the lowest after the embryos had been uv-irradiated with $\lambda = 254$ nm at the stage of syncitial preblastoderm. Sex determinants of the polar plasm were most sensitive in embryos at the cleavage stage after uv-irradiation with $\lambda = 313$ nm. It was suggested that in the latter case the synthesis of proteins required for the development of gonocytes involving polar granules and ribosomes in the anucleated polar cytoplasm was most susceptible. (auth)

3677 TRANSMISSION OF TRAITS IN PARTHENOGENETIC ARTEMIA SALINA. Ballardin, E.; Metalli, P. (CNEN, Rome). Boll. Zool.; 39: No. 4, 551-564(1972). (In Italian). (RT/BIO-(73) 26).

Experiments of phenotypic selection on individual metric traits were carried out using two diploid meiotic laboratory strains, and one tetraploid strain with simple maturative mitosis of oocytes. Fertility (hatching percentage of "viviparous" eggs) and the number of setae implanted on the furca were measured over several generations under constant conditions of breeding and culture techniques. A phenotypic hereditary variant was also isolated from the tetraploid strain and its frequency was measured over five generations. All the experiments showed a remarkable stability of the means of the traits under consideration, accompanied by a large individual variability. A significant response to selection was always obtained (after x irradiation in the tetraploid strain); the responses were characterized by rapid rates of change of the means, rapid exhaustion after few generations, and by a remarkable degree of stabilization at the new levels obtained through selection. Decreased individual variability was invariably observed in all selected lines. The results are discussed in terms of the possible mechanisms by which transmission of traits may be controlled, and some hypotheses are considered about the origin and the nature of genetic variability in parthenogenetic Artemia. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstract 3173.

Man

Refer also to abstracts 3175, 3759, and 5701.

3678 INTRA-ARTICULAR INJECTION OF RADIOISOTOPIC BETA EMITTERS. Application to the Treatment of the Rheumatoid Hand. Menkes, C. J.; Tubiana, R.; Galmiche, B.; Delbarre, F. (Hopital Cochin, Paris). Orthop. Clin. N. Amer.; 4: No. 4, 1113-1125(Oct 1973).

The combined use of intra-articular injection of radioisotopes and surgical treatment represents real progress in the management of the rheumatoid hand. One should act before severe destruction occurs, when only surgical reconstruction such as anthroplasty and arthrodesis is indicated. Our experience with radioactive isotope injections indicates the value of this treatment to replace early surgical synovectomy. The latter should be considered only after injection of radioactive substances. This approach appears to us to be more justified than early surgical synovectomy carried out on a joint that is not yet distended, since the surgical procedure is neither simple nor free of complications. Because of the risk of the skin necrosis, only β emitters of low energy and of shallow penetration, such as ^{169}Er can be utilized for the treatment of the fingers. Although for the large joints, such as the knee, there is a statistically significant relationship between the results obtained and the radiological appearance of the joint, in the hand and the wrist improvement can be obtained even when the articular surfaces have been involved in the disease process. In general the results in the wrist are less favorable than those in the small joints of the finger. This can be explained by the difficulty in attaining uniform irradiation of a synovium that is in many folds. Increases in the dosage and frequency of injection will undoubtedly permit improvement in the results. However, at the wrist the indications for and the results of surgical intervention are more favorable than for the fingers. Thus, injection of radioactive substances along with surgical synovectomy offers greater possibilities for the treatment of early rheumatoid arthritis of the hand. (auth)

3679 SIMPLIFIED ABSORBED FRACTION METHOD FOR RADIATION DOSE CALCULATIONS IN ROUTINE CLINICAL SITUATIONS. Chandra, R. (New York Univ. Medical Center, NY). Radiology; 111: No. 2, 415-416(May 1974).

The absorbed fraction (AF) method for the calculation of the radiation dose to a patient from the internally administered radionuclides, in spite of its conceptual simplicity and soundness, does not provide the desired rapidity and simplicity in routine clinical situations. An approximation was developed, which essentially maintains the conceptual soundness of the AF method and provides the desired simplicity and rapidity in routine clinical situations. The errors in calculations are, in general, less than 5%. These are systematic and predictable and can therefore be further reduced for a given radionuclide for better accuracy, if so desired. (auth)

3680 RECENT DEVELOPMENTS IN INDUSTRIAL CARCINOGENS. Eckardt, R. E. (Esso Research and Engineering Co., Linden, NJ). J. Occup. Med.; 15: No. 11, 904-907(Nov 1973).

Studies on effects of carcinogens on animals and man are reviewed. Some topics discussed are: carcinogenic effects of chemicals on skin of mice, hamsters, and rabbits; pulmonary carcinogenesis in animals following inhalation of beryllium, nickel carbonyl, and radioactive materials; pulmonary cancer in asbestos workers; lung cancer in uranium miners; lung cancer in metal smelter workers; leukemogenic effects of benzene; lung cancer in fluorspar miners; and lung cancer in coke oven workers. (HLW)

Animals

Refer also to abstracts 3193 and 3709.

3681 REACTIVE CHANGES IN THYMUS AND LYMPH NODE LYMPHOID TISSUE IN ADRENALECTOMIZED RATS FOLLOWING CESIUM-137 INCORPORATION. Khussar, Yu. P.; Tokin, I. B. (Tartu State Univ.). Biol. Nauki; 112: No. 4, 64-69(1973). (In Russian).

In tests on adrenalectomized rats it was established that internal irradiation with ^{137}Cs causes in the cortex of the thymus and in the suberous plateau of the lymph nodes very destructive changes in the lymphoid tissues and suppresses the mitotic division of the lymphoid cells. Appreciable recovery begins only 7 days after irradiation. Irradiation with ^{137}Cs has a direct effect on the lymphoid tissue. The role of the hypophysial-adrenal system consists in the acceleration of the elimination of decomposition products from the tissues by increased manufacture of ketosteroids. (tr-auth)

3682 TRITIUM TOXICITY: EFFECT OF LOW-LEVEL ^{3}HOH EXPOSURE ON DEVELOPING FEMALE GERM CELLS IN THE MOUSE. Dobson, R. L.; Cooper, M. F. (Univ. of California, Berkeley). Radiat. Res.; 58: No. 1, 91-100(Apr 1974).

Adult female mice were injected with ^{3}HOH on the day of fertilization to give prompt levels of tritium in body water of 8.5, 0.85, and 0.085 μCi/ml and started on drinking water containing 13, 1.3, and 0.13 μCi ^{3}HOH per ml to maintain these levels throughout pregnancy and lactation. Their female offspring, thus exposed to tritium from conception, were sacrificed at 14 days age, and oocytes were counted in serial sections of ovaries. Primary oocytes in these mice were decreased below control numbers by more than 90% at the 8.5 μCi/ml level and 30% at 0.85 μCi/ml. At 0.085 μCi/ml, a level substantially below those reported previously to cause measurable biological effects in mammals, a significant decrease was still observed. No evidence of a threshold was found. The data indicate that, by 14 days of age, a 50% decrease in the number of germ cells can be expected in a female mouse exposed continuously during development to approximately 2 μCi of tritium per ml body water. (auth)

3683 CHANGES IN THE CENTRAL NERVOUS SYSTEM CAUSED BY BETA RADIATION IN ANIMAL EXPERIMENTS. Csanda, E.; Szikla, G.; Vedrenne, C.; Talarach, J. Ideggyogy. Szemle; 26: No. 10, 451-465(Oct 1973).

The studies reported in this paper were carried out in France within the framework of the agreement on French–Hungarian cultural relations. ^{90}Y-labeled yttrium oxide rodlets were implanted into the brains of rabbits and the blood-brain barrier dynamics were evaluated as they were affected by the β-radiation. Histological observations were also made to analyze the temporal course of the edematogenic effect of the radioactive yttrium and to assess the interrelations between the various disturbances in the blood-brain barrier. The affected area was spherical and the disturbances were characterized by edema-like phenomena. The disturbances subsided slowly. Staining with Evans blue was not always a reliable indicator of the effects. The general results were similar to those observed in cases of perifocal edema; thus, patients treated with ^{90}Y should always be watched for cerebral edema. (JPRS)

3684 RESPONSE OF TESTES TO TP AND IRRADIATION IN THE INDIAN CATFISH, HETEROPNEUSTES FOSSILIS (BLOCH). Rathi, S. K. (Government Post-Graduate Coll., Rajasthan, India). Indian J. Zootomy; 10: No. 3, 175-190(1969).

Testosterone propionate (TP) when administered to the mature male fish resulted in 32% increase in weight of testes, indicating that TP stimulates spermatogenesis to a great extent. This was confirmed by histological studies of the treated testes. All the stages of the germ cells together with the presence of mitotic figures are evident. No phagocytosis or cellular damage was noticed. When TP was administered along with radioisotopes, there was a 13% reduction in the testicular weight. Only ^{32}P or ^{60}Co treated testes lose 14 or 3% of their weight respectively. Microscopical study of TP + irradiated or irradiated testes reveals that there are degenerative features like damaged and disintegrated cells, disturbed mitotic figures, phagocytosis, and destruction of nuclei. These observations indicate that stimulating effect of TP on irradiated testes is not noticed. (Indian Sci. Abstr.)

Nuclide Kinetics and Toxicology

Refer also to abstract 3167.

Man

Refer also to abstracts 3718, 3727, and 3740.

3685 RISK OF INTERNAL RADIOACTIVE CONTAMINATION. Current and Prospective Problems. Maugeri, S. (Univ., Pavia, Italy). Lav. Umano; 25: No. 2, 34-50(Mar 1973). (In Italian).

The introductory lecture in a course of radiotoxicological techniques for radioprotection is presented. The concepts of biological half-life, radioactive half-life, and critical organ are introduced and defined. The factors affecting internal radioactive contamination are the absorption of the contaminant, its distribution in various systems, and its elimination and these are discussed in detail. The industrial uses of radiation sources are reviewed as a possible source of internal contamination. Contamination of the food chain by radioactive wastes or fallout is discussed. The effects of internal contamination in the production of lesions and mutations are briefly indicated. (JSR)

3686 ELIMINATION OF FREE AND PROTEIN-BOUND IONIC MERCURY ($^{203}Hg^{2+}$) IN MAN. Rahola, T.; Hattula, T.; Korolainen, A.; Miettinen, J. K. (Univ. of Helsinki). Ann. Clin. Res.; 5: No. 4, 214-219(1973).

The retention and elimination of inorganic mercury (Hg^{2+}) in man were investigated using ^{203}Hg-labelled compounds and the whole-body counting technique. Ten volunteers each received single doses of either protein-bound or free ionic inorganic mercury, as follows. Eight of the volunteers, five males and three females, were each given 4 to 8 μCi of $^{203}Hg(NO_3)_2$ bound to calf liver protein containing approximately 6μg inactive Hg per dose as carrier. The remaining two volunteers (females) received 4 and 14 μCi of $^{203}Hg(NO_3)_2$ in an aqueous solution containing about 6 μg inactive Hg per dose as carrier. Whole-body counting of the subjects was performed in an iron room using the standard-chair geometry and one 4'' × 8'' NaI(Tl)-crystal. Feces, urine, and blood samples were also collected and counted. On average, 85% of the ^{203}Hg activity was excreted within the first 4 to 5 days, principally in feces. The amount excreted in urine during the same time period was only 0.17%. The biological half-time of ^{203}Hg (slow component) was found to be 42 ± 3 days. Red cells were determined to have a shorter biological half-time, 28 ± 6 days; for ^{203}Hg. The ratio of mercury activity in red cells to that in plasma was 0.4. (auth)

3687 UPTAKE OF RADIOACTIVE ^{85}Sr BY THE SPINE IN PATIENTS WITH UNTREATED AND TREATED HYPERTHYROIDISM. Anttonen, V. M.; Karjalainen, P.; Raunio, H.; Holopainen, T. (Kuopio Univ., Finland). Ann. Clin. Res.; 5: No. 4, 225-230(1973).

The uptake of ^{85}Sr by the spine was measured in 18 hyperthyroid patients before treatment and in 10 of them also after treatment. The control series consisted of 39 subjects without evidence of bone involvement or disturbances in calcium kinetics. The mean of the ^{85}Sr uptake values was significantly higher in the hyperthyroid patients than in the control subjects ($p < 0.0001$). The ^{85}Sr uptake was also significantly higher in the hyperthyroid state compared with the post-treatment values ($p < 0.05$). There was no significant difference between the ^{85}Sr uptakes of the treated euthyroid patients and the controls. A close correlation was found between thyroid status and the uptake of ^{85}Sr in the spine and there was a tendency for hydroxyproline levels in the urine and the uptake of ^{85}Sr in hyperthyroidism to increase. (auth)

3688 INTAKE AND URINARY EXCRETION OF URANIUM IN NON-OCCUPATIONALLY EXPOSED PERSONS. 1. Recovery of Uranium in the Daily Diet and Urine. Masuda, K. (Okayama Univ., Japan). Nippon Eiseigaku Zasshi; 26: No. 5, 434-437(Dec 1971).

The amount of uranium in the daily diet and human urine was measured by means of solid fluorimetry and the accuracy of this test was established. Recovery of the dietary uranium was 52.61 ± 4.34% at the 95% confidence level. As the coefficient of variation was small, it was concluded that this method can be used for the measurement of dietary uranium. Recovery of human urinary uranium was 87.72 ± 1.88% at the 95% confidence level. (auth)

3689 INTAKE AND URINARY EXCRETION OF URANIUM IN NON-OCCUPATIONALLY EXPOSED PERSONS. 2. Uranium in the Daily Diet. Masuda, K. (Okayama Univ., Japan). Nippon Eiseigaku Zasshi; 26: No. 5, 438-441(Dec 1971).

Daily dietary intake of uranium was measured in persons living in the vicinity of a uranium mine and refinery in Okayama Prefecture, Japan. No seasonal variations were seen in uranium intake, however a significant difference (P = 0.01) in uranium intake was seen between the test and control villages and significant differences were seen among three test villages. (auth)

3690 INTAKE AND URINARY EXCRETION OF URANIUM IN NON-OCCUPATIONALLY EXPOSED PERSONS. 3. Urinary Excretion of Uranium. Masuda, K. (Okayama Univ., Japan). Nippon Eiseigaku Zasshi; 26: No. 5, 442-446(Dec 1971).

Uranium excreted in urine from non-occupationally exposed persons was measured by means of solid fluorimetry. Subjects were residents of three villages in the vicinity of a uranium mine and refinery in Okayama, Japan, and one village in Okayama served as the control village. Significant differences in the urinary excretion of uranium were noted among all the test villages as well as a comparison to the control. (auth)

3691 INTAKE AND URINARY EXCRETION OF URANIUM IN NON-OCCUPATIONALLY EXPOSED PERSONS. 4. Discussions on Dietary Intake and Urinary Excretion of Uranium. Masuda, K. (Okayama Univ., Japan). Nippon Eiseigaku Zasshi; 26: No. 5, 447-450(Dec 1971).

The mean of the dietary intake of uranium in the region of a uranium mine was 3.190 to 9.150 μg/day/person, while that in the region of the control was 1.771 μg/day/person. The mean of the urinary excretion of uranium was 0.027 to 0.147 μg/day/person in the test areas and 0.006 μg/day/person in the control area. When the dietary intake (x μg) was within a range of 1.771 to 9.150 μg/day/person, x was related to the urinary excretion (y μg) as follows: $y = (0.00274)x^{1.71}$. (auth)

3692 CONCENTRATION OF PLUTONIUM-239, STRONTIUM-90, AND CESIUM-137 IN HUMAN ORGANS OF THE NORTHERN JAPANESE IN THE LAST TEN YEARS. Takizawa, Y. (Niigata Univ., Japan); Kosaka, T.; Sugai, R.; Izawa, M.; Watanabe, H. Nippon Koshu Eisei Zasshi; 19: No. 5, 251-255(May 1972). (In Japanese).

The determination of β radioactivity, plutonium-239, strontium-90, and cesium-137 in different organs of human beings has been carried out to know the accumulated amount and the distribution of the radionuclides from the environmental contamination by radioactive fallout in the Niigata districts along the Japan Sea, especially in the northern Japan. The samples of bone (rip), genital, lung, spleen, muscle, kidney, brain, and liver were obtained from the Hospital of Niigata University School of Medicine. The counting samples were prepared by a method published by the Science and Technology Agency and the radioactivities were measured by the Aloka LBC-22 G-M counter and γ spectrometer. The recent gross estimation of radioactivity (counts per minute) in human body shows a decrease to 1/6 to 1/40 of that around 1957, reflecting fluctuation of the fallout in recent years. The evaluation of cumulative amounts of the long-lived nuclides ^{239}Pu, ^{90}Sr, and ^{137}Cs, found much in such principal organs as bone, gonad and spleen, indicates some recent increase. (auth)

3693 PENETRATION OF TRITIUM IN THE SKIN RESULTING FROM THE UTILIZATION OF RADIOLUMINESCENT PAINTS. Billaudelle, H. (Konigswinter Oberdollenbach, Frankfurt am Main); Kaltenhauser, A. Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 219-226(Oct 1973). (In French).

An attempt was made to overcome the disadvantages resulting from the release of tritium by evaporation from tritiated luminous paints. Very often luminous paints are applied by hand without protective gloves in badly ventilated rooms. Such handling leads to the ingestion of varying amounts of tritium by the persons employed, the tritium entering the organism by both the respiratory tract and the skin. It was demonstrated possible to reduce the amount of tritium inhaled by working under a suction hood. Various experiments showed that a 60% reduction in the amount of tritium ingested could be achieved in this way. The urine tritium activity diminishes as soon as a hood is used for the work and begins to increase as soon as the hood is removed. A specially designed radioprotection hood was employed in which a powerful extractor is used to reduce the pressure. Carefully controlled working conditions can be used to avoid ingestion resulting from skin absorption. (FR)

3694 GOLD KINETICS FOLLOWING AUROTHIOMALATE THERAPY: USE OF A WHOLE-BODY RADIATION COUNTER. Gerber, R. C.; Paulus, H. E.; Jennrich, R. I.; Lederer, M.; Bluestone, R.; Blahd, W. H.; Pearson, C. M. (Veterans Administration Hospital, Los Angeles). J. Lab. Clin. Med.; 83: No. 5, 778-789(May 1974).

Aurothiomalate is frequently used to treat severe rheumatoid arthritis, but is an unusual drug since the beneficial effects of therapy occur only after 2 to 5 months of treatment and may persist for 6 to 12 months after administration is discontinued. Balance studies have related this to delayed excretion of the drug, resulting in its accumulation in the body during therapy. Using a whole-body radiation counting chamber, the retention of a single intravenous dose of ^{195}Au-aurothiomalate was measured in 11 patients and 2 healthy volunteer subjects for as long as 262 days. Following tracer injection the patients received intercurrent stable gold therapy. Volunteer subjects received only tracer. Balance studies, determined in 7 patients for 7 days, correlated well with body-retention data. Whole-body retention conformed closely to a two-compartment linear model. Rates of movement of tracer into and out of the 2 compartments were calculated from a mathematical model. Sixty days after the tracer was injected into the patients, 43% remained unexcreted. The observed clearance of tracer from serum conformed to first order kinetics with a mean half-time of 5.5 ± 0.4 days. Initial volume of distribution, calculated by extrapolation of the serum clearance curves, was 6.6 ± 0.6 liters. This study quantitates, by direct measurement, the prolonged retention of gold in patients undergoing conventional chrysotherapy. Prolonged body retention is consistent with the prolonged duration of benefit seen with this drug in clinical use. (auth)

3695 ELECTIVE UPTAKE OF RADIOIODINE BY CANCER OF THE STOMACH. Clode, W. H.; Sobral, J. M. V.; Lima Basto, E.; Baptista, A. M. (Instituto Portugues de Oncologia, Lisbon). Arq. Patol. (Lisbon); No. Special Suppl., 399-401(Feb 1972).

In all of the patients studied until now, it was shown that cancer of the stomach is indeed able to pick up radioiodine and that its specific radioactivity is higher than that of the normal gastric mucosa. Scanning over the stomach region also showed a higher concentration of the radioactivity over the tumor in accordance with the previous findings. These facts suggest a new diagnostic procedure for cancer of the stomach, because in normal patients (hyperthyroid patients who were treated with radioiodine) we have never observed similar findings. The results are particularly interesting because until now, an increased radioiodine uptake detected over a region was related to the possible existence of a metastasis of thyroid cancer. Work is being done to extend the number of observations and, in particular, to study the biochemical and metabolic aspects of this problem and its possible implications in the diagnosis and therapy of cancer of stomach. (auth)

3696 ICRP STANDARDS ON INTERNAL CONTAMINATION BY RADIOACTIVE DUSTS. Nooteboom-Beekman, Z. M. Atoomenergie Haar Toepass.; 15: No. 7-8, 171-175(Jul 1973). (In Dutch).

From symposium on permissible doses of ionizing radiation; Groningen, Netherlands (26 Apr 1973).

The ICRP limits for internal contamination are based on the maximum permissible doses, that apply to both external and internal radiation. In ICRP-Publication 2 a model of continuous, constant intake during a 50-year period together with a single exponential compartment model is used for calculation of maximum permissible concentrations in air and water. At the moment this publication is under complete revision, and other intake, retention, and elimination models will be used. Permissible intakes with corresponding body retentions and excretion levels for single intakes and for more complex intake patterns are given in ICRP-Publication 10 and 10A. The models used by the ICRP are explained. (auth)

3697 DISTRIBUTION AND RETENTION OF THE ANTITUMOR AGENT ^{195m}Pt-cis-DICHLORODIAMMINE PLATINUM(II) IN MAN. Smith, P. H. S.; Taylor, D. M. (Royal Marsden Hospital, Sutton, Eng.). J. Nucl. Med.; 15: No. 5, 349-351(May 1974).

Body distribution and retention of cis-dichlorodiammine platinum, including liver uptake, were measured in two patients with cancer by whole-body counting and scanning and determinations of radioactivity in blood and excreta. (auth)

3698 PENETRATION OF RADIOACTIVE MATERIAL INTO BIOLOGICAL TISSUE. Kusak, V.; Janisch, R.; Jelinek, S.; Ruezek, J. Cesk. Otolaryngol.; 22: No. 5, 262-266(Oct 1973). (In Czech).

The authors deal with the problem of penetration and storage of radioactive material in various biological tissues, as observed in the in vitro experiments, as in vivo in the miners of uranium mines. In vitro, there is a metabolic processing and a growth stimulation. In vivo, this material is stored in the lymphatic tissue of palatal tonsils without any manifestations of changes caused by ionizing radiation. (auth)

3699 FORECASTING ^{137}Cs IN HUMANS RESULTING FROM ^{137}Cs IN REACTOR EFFLUENTS. Pendleton, R. C.; Lloyd, R. D. (Univ. of Utah, Salt Lake City). Health Phys.; 26: No. 4, 351-358 (Apr 1974).

A mathematical model is presented, previously used by Lloyd et al., (Radiol. Hlth. Data Rep.; 10: 427 (1969) and Health Phys.; 24: 23 (1973)) that predicts with reasonable accuracy the concentration of ^{137}Cs in humans ($^{137}Cs/K$ = pCi ^{137}Cs/g potassium) when considering the relationship between human body burdens of ^{137}Cs and the fallout ^{137}Cs content in their milk supply. This model is presented here in a form that is readily adaptable to predictions of human $^{137}Cs/K$ based on milk $^{137}Cs/K$ specifically resulting from ^{137}Cs in reactor effluents. This analysis of the predictive model is intended to allow such calculations to be performed without the need for tedious and repetitive month by month solution of the model so that required predictions of human $^{137}Cs/K$ can be made quickly and easily for planning purposes. The model could also be of use in planning protective measures in the case of accidental ^{137}Cs releases. (UK)

Animals

Refer also to abstracts 3507, 3715, 5767, and 5769.

3700 (CEA-R-4548) EXPERIMENTAL CONTAMINATION BY CHROMIUM-51 OF ANGUILLA ANGUILLA. Descamps, B.; Foulquier, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). Feb 1974. 100p. (In French). Dep. NTIS (US Sales Only) $8.00.

Because of their wide geographical distribution, their physiological characteristics, and their economic interest, eels are an ideal species for studying the mechanisms of radionuclide concentration. Eels weighing 25 to 30 g were kept in fresh water aquaria without nourishment. By measuring the radioactivity levels of live eels it was possible to observe the dynamics of ^{51}Cr fixation, and the specific activity of individual organs was calculated after the eels had been dissected. After 45 days of contamination the fish retained 0.5% of the activity introduced. The maximum specific activity was reached about 20 days after contamination, when the overall concentration factor for the animal approached 1.7. The intestine was particularly important and after 7 days it accounted for 70% of the total activity in the animal. There were two phases in the desorption of ^{51}Cr: a fast one corresponding to a biological half-life of about four days and a slower one with a biological half-life of about 65 days. (FR)

3701 (CONF-720486-, pp 39-48) SOME FACTORS AFFECTING THE BIOLOGICAL HALF-LIFE OF ^{51}Cr AND ^{32}P IN THE ORIENTAL MIGRATORY LOCUST. Viado, G. B.; de la Paz, L. R.; Yenko, E. M.; Gapusan, E. M. 1972.

From joint annual convention of the radioisotope and nuclear medicine meeting; Quezon City, Philippines (7 Apr 1972).

The biological half-life of ^{32}P is much longer than that of ^{51}Cr, hence, better suited as label for the oriental migratory locust in ecological studies. No apparent deleterious effect of ^{32}P was noted in the insects. ^{51}Cr showed some toxicity by shortening survival time. Metabolism of ^{51}Cr is quite different from that of ^{32}P in the body of the insects. (auth)

3702 (INIS-mf-887-2, pp 81-92) MODEL EXPERIMENTS WITH ^{131}I DISTRIBUTION IN ORGANS OF MICE DEPENDING ON MODE OF ADMINISTRATION. Stollarova, N.; Mraz, L. (Safarika Univ., Koscie, Czech.). [nd]. (In Russian).

Experiments are described aimed at ascertaining the distribution of ^{131}I in various organs of mice in relation to the manner of administration. The experiments showed that fluctuations in the weight of individual organs were smaller than fluctuations in activity. For a selected group of animals of optimum age and weight, the activity distribution can therefore be studied without the necessity of weighing the respective organs, provided the average weight of the organs has been found beforehand. (INIS)

3703 DISTRIBUTION AND EXCRETION OF ^{203}Hg-MERCURIHYDROXYPROPANE, ^{203}Hg-CHLORMERODRIN, AND ^{203}Hg-SALYRGAN. Ogawa, E.; Suzuki, S.; Tsuzuki, H.; Kawajiri, M.; Kito, H. (Gunma Univ., Maebashi, Japan). Kitakanto Igaku; 23: No. 1, 55-67(Jan 1973). (In Japanese).

With increased application of radioactive pharmaceuticals, exposure of patients to radiation has attracted grave attention. Especially when mercuric preparations are used, the kidney is exposed to a large dose. To eliminate the radioactive substance as early as possible after receiving diagnostic information is one of the measures to relieve the patient from radiation injury. Male ddN mice were used as experimental animals. Tracer doses of various radioactive mercuric preparations were intraperitoneally injected to them, and radioactivity was daily measured for 3 days with animal bodies and their excrements, using the whole-body animal counter, and at 3 days radioactivity of ^{203}Hg in various organs was determined with the well-type scintillation counter. From immediately after the radioisotope injection, various drugs (in doses varying by toxicity) were given every 24 hours, that is, once daily for 3 days and effects on the retention, excretion, and organ distribution of ^{203}Hg were examined to evaluate the eliminating activities. Drugs that decreased the retention of ^{203}Hg-MHP and accelerated its urinary excretion were BAL, mercaptoacetic acid (MAA), 2-mercaptopropionyl glycine, (MPG), DL-penicillamine (Pen.), and GSH. Furosemide conversely increased the retention. L-CySH, Rongalite, and EDTA elicited no change. Drugs that were effective for elimination of ^{203}Hg-chlormerodrin were MPG, MAA, and Pen. BAL lowered ^{203}Hg concentration in the kidney, but elevated it in the liver and brain. GSH decreased ^{203}Hg in the brain and pancreas, but did not change its amount in the other organs. Furosemide increased ^{203}Hg in the liver and pancreas. EDTA, DTPA, and Rongalite exerted no effect. Drugs that were effective for elimination of ^{203}Hg-Salyrgan were MPG, GSH, Pen, and Rongalite. Furosemide and BAL increased the retention. All the mercuric compounds were increased in body retention under fasting condition. Effect of eliminating them differed in different compounds. The distribution and excretion of these mercuric compounds administered s.c. or i.p. into Ehrlich ascites cancer-bearing mice were also examined. (auth)

3704 ACCUMULATION OF NATURAL ALPHA EMITTERS IN SPANISH GASTROPODS IN RELATION WITH THE ACTIVITY PRESENT IN SOILS AND PLANTS. Alvarez Ramis, C.; Gregorides de los Santos, A. Energ. Nucl. (Madrid); 17: No. 85, 357-362(1973). (In Spanish).

The relations which exist between the contaminations of gastropods, soils, and vegetation of the biosphere are studied for a large number of Spanish provinces. Conclusions of a general character are made on the low possibility of contamination of this group. The results indicate that gastropods can not be used as indicators of the incorporation in the food chain of biocenosis contaminated with α emitters. (tr-auth)

3705 EFFECT OF ANOXIA ON ^{32}P INCORPORATION INTO ATP. Study of the Mitochondria in the CNS of Rats of Different Ages. Mourek, J.; Pruzkova, V.; Prokes, J.; Stavovcikova, O. (Charles Univ., Prague). Physiol. Bohemoslov.; 23: No. 1, 37-43(Mar 1974).

The authors studied ^{32}P incorporation into the ATP of a mitochondrial suspension in correlation to anoxia and the rats' age, The mitochondria were isolated from the cerebral cortex by fractionated centrifugation after Milstein et al. (1968), in 5-day-old and adult rats. Before the experiment the rats were exposed to nitrogen anoxia lasting 80% of the lethal time for the given age group. The isolated mitochondria were incubated (Dubnoff) either for 10 min at 30°C, or 35 min at 37°C. Before starting incubation, ^{32}P was added to the mitochondrial suspension in a dose of 10 μCi/ml suspension. Glutamate (0.01 M) acted as the metabolic substrate. The purity of the mitochondria was verified electronoptically. Total mitochondrial protein was assayed after Cleland and Slater (1953). ^{32}P incorporation into ATP was determined on the basis of the extraction of metabolites of phosphoric acid esters with isobutanol and benzene after Nielsen and Lehninger (1955) and Pullman (1967). Radioactivity was measured on a Tesla NQZ 615 automatic counter with a SPD 22 Tesla scintillation detector for beta particles. The results are expressed as percentage of total P (100%) in the incubation medium incorporated into the ATP fraction per milligram of mitochondrial protein. Anoxia preceding 10 minutes' incubation significantly reduced the amount of ^{32}P incorporated into ATP in the mitochondrial suspension from the cerebral cortex of adult rats. The rate of incorporation in 5-day-old rats was not affected by preceding anoxia. In the second series (35 min incubation at 37°C), preceding anoxia caused a significant increase in ^{32}P incorporation into mitochondrial suspension ATP in 5-day-old rats, while in adult rats the rate of incorporation fell (non-significantly, by 18%). (auth)

3706 DISTRIBUTION AND DOSIMETRY OF TRITIUM IN NEWBORN RATS AFTER IN UTERO EXPOSURE TO ^{3}H-TdR.

Schreml, W. (Univ., Ulm, Ger.); Haas, R. J.; Planas-Bohne, F.; Steinhardt, B. Radiat. Res.; 58: No. 2, 239-252(May 1974).

In order to explore the suitability of continuous ^{3}H-TdR infusion into pregnant rats for radiotoxicity studies in the offspring, the incorporation of tritium into the developing animals was studied by biochemical means. In the offspring, the total incorporated activity (μCi/g wet weight) and the specific activity of DNA (μCi/mg DNA) show a direct relationship to the tritium activity applied to mothers. The distribution of activity between DNA and acid soluble fraction is organ specific, but independent of the activity applied. The slopes of the regression lines for DNA specific activity are organ specific. These facts have to be taken into consideration when dose calculations are attempted. On the other hand, the direct relationship between activity applied to mothers and the incorporation into the offspring establishes the system of continuous ^{3}H-TdR infusion into pregnant rats as a suitable model to study ^{3}H-TdR toxicity in mammalian cells under conditions in which all cell nuclei are exposed to DNA-bound tritium. (auth)

3707 BIOLOGICAL AND CHEMICAL PROPERTIES OF ^{197}Hg-CHLORMERODRIN. Jovanovic, V.; Zmbov, B.; Bzenic, J. (Boris Kidric Inst. for Nuclear Research, Belgrade). Nucl.-Med.; 12: No. 4, 335-340(Jan 1974).

The results obtained in the investigation of radiochemical purity of a ^{197}Hg-CM preparation are presented, the distribution of ^{197}Hg-CM in the organs of experimental animals was also investigated. It was found that maximum radioactivity is reached in the kidneys after the second hour following injection and also that the hydroxy form of ^{197}Hg-CM is excreted with urine while its content in the urine increases with increasing retention time of the preparation in the organism. (auth)

3708 DEPENDENCE OF THE ACCUMULATION OF RADIONUCLIDES IN THE TISSUES OF FISH ON TEMPERATURE AND SALINE CONDITIONS IN THE ENVIRONMENT. Lyapin, E. N.; Gusev, D. I.; Katkov, A. E.; Podgurskii, A. M.; Nechaev, L. I. Tr., Atl. Nauch.-Issled. Inst. Ryb. Khoz. Okeanogr.; No. 44, 45-59(1973). (In Russian).

Findings are presented of an experimental study of the accumulation of cesium-137, strontium-90, cerium-144, antimony-125, chromium-51, iron-59, cobalt-60 and ruthenium-106 in the tissues of fish (golden carp, lake ruff, rainbow trout) at 0 and 17°C in fresh water (mineralization up to 100 milligrams per liter) and in artificial sea water. (JPRS)

3709 PROMETHIUM BIOLOGICAL CONSIDERATIONS. Thompson, R. C. (Battelle Pacific Northwest Labs., Richland, WA). pp 161-176 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

The biological literature on promethium, with a single notable exception, is limited to nonhuman studies. Experiments with animals have dealt with the uptake of promethium by various routes, its distribution within the body, and measurements of retention and excretion. Toxicity studies are few; however, data from other radionuclides of similar behavior can be relied upon to provide qualitative information in this area. The biology of promethium is discussed under the following headings: routes of entry and initial distribution, injection studies, ingestion studies, inhalation studies, and absorption through the skin; retention and excretion of promethium; therapeutic removal of promethium, and toxicity of promethium. (auth)

3710 KINETICS OF POLONIUM-210 IN THE TISSUES OF FISH AT 0°C AND IN WATER OF DIFFERENT SALINITIES. Katov, A. E.; Lyapin, E. N.; Gusev, D. I.; Nechaev, L. N. Tr., Atl. Nauch.-Issled. Inst. Ryb. Khoz. Okeanogr.; No. 44, 60-65 (1971). (In Russian).

The kinetics of the accumulation and the character of metabolism of polonium-210 were investigated in tissues in simulated winter conditions of habitation in water of different salinities. (JPRS)

Plants

Refer also to abstract 5764.

3711 (LA-UR-74-588) STUDIES OF THE APPARENT SOLUBILITY OF $^{238}PuO_2$ MICROSPHERES IN AN AQUATIC ENVIRONMENT AND THE UPTAKE OF PLUTONIUM FROM A SOIL MATRIX CONTAINING $^{238}PuO_2$. Adams, W. H.; Fowler, E. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 31p. (CONF-740406-7). Dep. NTIS $4.75.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

The uptake of plutonium by lettuce and barley from soil spiked with $^{238}PuO_2$ microspheres is described. A four year study of the effect of simulated soil stresses on the concentration factors of plutonium is presented. The apparent solubility of $^{238}PuO_2$ microspheres in tap water is determined and the deposition of plutonium in fish, algae, and snails in aquaria containing $^{238}PuO_2$ microspheres is reported. These data may be used to assess the hazard associated with the loss of a Systems for Nuclear Auxiliary Power device. (auth)

3712 (UCB-34-P-211-1) UPTAKE OF PLUTONIUM AND AMERICIUM BY PLANTS FROM SOILS. Schulz, R. K.; Tompkins, G. A.; Babcock, K. L. (California Univ., Berkeley (USA). Dept. of Soils and Plant Nutrition). 1 Mar 1974. Contract AT (04-3)-34. 19p. Dep. NTIS $4.00.

Progress is reported on a study on the uptake of Pu and Am by plants from soils. Much of the time of the first year of this project was spent on endeavoring to obtain various necessary permits associated with use of fissionable materials. Five California agricultural soils were collected for use in this investigation, and analyzed for properties such as pH, parent material, and organic matter content. Two soils contaminated with Pu and Am were collected from the Nevada Test Site, and two paired cold control soils were collected from the Nevada Test Site. (CH)

New Tracer Techniques

Refer also to abstracts 2480, 2493, 2567, 2570, 2579, 2581, 2583, 2642, 2646, 2811, 2842, 2845, 3258, 3308, 3314, 3477, 3657, 3695, and 3697.

3713 (SGAE-2230) AUTORADIOGRAPHIC STUDIES OF THE UNSCHEDULED DNA SYNTHESIS IN SYSTEMIC LUPUS ERYTHEMATOSUS (LSE) AND PRIMARY CHRONIC POLYARTHRITIS (PCP). Tuschl, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Jan 1974. 22p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Unscheduled DNA synthesis was investigated in peripheral lymphocytes of patients with systemic lupus erythematosus and chronic polyarthritis to demonstrate a possible relationship between the production of DNA antibodies and reduced DNA repair capacity. After irradiation with 60 krad ^{60}Co γ or 7500 erg/mm^2 uv respectively, the incorporation of ^{3}H-TdR in the presence of hydroxyures was tested by autoradiography. New Zealand White and New Zealand Black Mice, which produce similar immunological phenomena, were tested for comparison. Likewise parallels between rhematoid arthritis (RA) and a mycoplasma-induced arthritis were demonstrated. The percentage of labelled cells in the lymphocyte population and the average grain number per cell were calculated. (auth)

3714 INVESTIGATION OF IRON KINETIC, ERYTHROKINETIC, AND VOLUMETRIC PARAMETERS WITH DOUBLE AND TRIPLE ISOTOPE LABELLING. Nemessanyi, Z. (Szeged Orvostudomanyi Egyetm, Hungry); Csernay, L.; Kulscar, F. Izotoptechnika; 17: No. 1, 24-32(Jan 1974). (In Hungarian).

The simultaneous determination of plasma volume with ^{125}I-albumin, volume and relative life of erythrocytes with ^{51}Cr, and iron kinetic parameters with ^{59}Fe-citrate in the same sample is discussed. The method is applicable to diagnostics. (auth)

3715 AUTORADIOGRAPHIC STUDIES ON THE DISTRIBUTION OF ^{131}I-19-IODOCHOLESTEROL IN DOGS. Ide, H. (Hisamitsu Pharmaceutical Co., Inc., Tosu, Japan); Sonoda, T.; Ogawa, H.; Nitta, K.; Kojima, M. Radioisotopes (Tokyo); 22: No. 10, 566-571(Oct 1973). (In Japanese).

The distribution of ^{131}I-19-Iodocholesterol in dogs weighing 2.0 to 2.4 kg was investigated by means of whole-body autoradiography. Good whole-body autoradiograms were obtained in slices of 40 to 60 μ with the Cryomicrotome JCMT-1A, which has recently been developed. As animals big in body size were used for examination, small organs such as adrenal gland and thyroid were easily analyzed. The ^{131}I-19-Iodocholesterol accumulated markedly in the adrenal cortex in 168 hrs. after the administration, and it accumulated in the thyroid, too. Continuous administration of potassium iodide (KI) prevented ^{131}I-19-Iodocholesterol accumulation in the thyroid, and Iodocasein, which has less side effects, was found to have the similar effects in the blocking of the thyroid. (auth)

3716 ^{131}I-BSP BLOOD RETENTION TEST. 10 Min. After Injection of 20 μCi of ^{131}I-BSP. Maeda, T.; Ueno, K.; Aburano, T.; Hisada, K. (Kanazawa Univ., Japan). Kaku Igaku; 10: No. 6, 571-575(Dec 1973). (In Japanese).

Iodine-131 labeled BSP blood retention tests were performed in 127 subjects including 35 with proven normalcy, 39 with proven liver diseases, 30 with proven extrahepatic diseases, and 23 with diagnosis unproven, based on clinical signs, laboratory data, and/or liver scannings. We utilized ^{131}I-BSP kits supplied by Dainabott R. I. laboratory, Ltd. The ^{131}I-BSP blood retention

ratio was measured at 10 min. after intravenous injection of 20 μCi of ^{131}I-BSP solution. The circulation blood volume was predicted by methods of Ogawa & Fujita's equation. The radioactivity of sample was counted during 5 min with a well-type scintillation counter. The ^{131}I-BSP blood retention ratio was calculated according to the following formula, where Sa is cpm of sample of 1 ml, St is cpm of 20 μCi ^{131}I-BSP, B is cpm of back grounds, and C ml is predicted circulating blood volume: (Sa-B) × C - (St-B) × 100 = ^{131}I-BSP blood retention ratio (%). In this method, the relative error ratio was within 5%. The ^{131}I-BSP blood retention ratios of healthy persons were 16.8 ± 5.4%, and those of hepatic diseases were more elevated values (for example, chronic hepatitis was 28.6 ± 9.6%, and liver cirrhosis was 47.7 ± 6.7%). The coefficient of correlation of ^{131}I-BSP blood retention ratios and I. C. G. (values at 15 min.), BSP retention test (values at 45 min.), G. P. T., and G. O. T. were obtained 0.81, 0.67, 0.57, and 0.44 respectively. Our data strongly suggest that a dose of 20 μCi of ^{131}I-BSP is enough for screening liver function. The reduction of a dose obviously decreases the exposure dose of patients. (auth)

3717 USE OF SCANNERS AND GAMMA CAMERAS FOR HYPOTHYROIDISM STUDIES. Hazard, J.; Galle, P.; Bernheim, R.; Perlemuter, L.; Chanzy, O.; Guilhaume, B.; Begon, F. (Hopital Henri-Mondor, Creteil, France). Nouv. Presse Med.; 2: No. 42, 2791-2795(24 Nov 1973). (In French).

Comparisons were made of the results obtained with a scanner and a gamma camera for 64 persons suffering from hyperthyroidism. It was observed that the gamma camera has advantages over the scanner: higher quality images are obtained permitting the thyroid morphology corresponding to ^{131}I fixing levels ranging from 10 to 20% to be examined. In addition, images can be obtained when the fixing level is very low (<5%). The characteristics of idiopathic myxedema in adults can be determined using this fixed detector. (FR)

3718 ASSESSMENT OF ALVEOLAR DEPOSITION AND PULMONARY CLEARANCE OF RADIOPHARMACEUTICALS AFTER NEBULIZATION. Isitman, A. T.; Manoli, R.; Schmidt, G. H.; Holmes, R. A. (Medical Coll. of Wisconsin, Milwaukee). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 4, 776-781(May 1974).

Radiopharmaceuticals in clear solutions can be deposited into the alveoli consistently with ultrasonic nebulization at tidal breathing. Of the four agents nebulized $^{99m}TcO_4$, ^{111}In-DTPA, $^{111}InCl_3$ and ^{99m}Tc-Sn-phytate, the ^{99m}Tc-Sn-phytate demonstrates the best alveolar deposition and the slowest pulmonary clearance. Only a minimal amount of the ^{99m}Tc-Sn-phytate is deposited in the tracheobronchial tree and negligible systemic absorption occurs. Preliminary results have shown that the ^{99m}Tc-Sn-phytate appears to correlate with ^{133}Xe ventilation images in the normal subject, but is equivocal in the chronic obstructive pulmonary disease patient. This is probably due to the mechanism of ^{99m}Tc-Sn-phytate deposition in the alveoli. The slow clearance of ^{99m}Tc-Sn-phytate allows imaging from four views routinely with excellent resolution and a relatively low radiation dose to the lungs. We are attempting to label inositol hexaphosphate with another radionuclide so that simultaneous dual radionuclide imaging can be obtained to map both the lung perfusion and bronchopulmonary patency. (auth)

3719 SIMPLIFIED RADIOIMMUNOASSAY FOR SERUM ALDOSTERONE UTILIZING INCREASED ANTIBODY SPECIFICITY. McKenzie, J. K.; Clements, J. A. (Univ. of Manitoba, Winnipeg). J. Clin. Endocrinol. Metab.; 38: No. 4, 622-627 (Apr 1974).

A shortened, simplified radioimmunoassay for serum aldosterone was made possible by the development of a highly specific antiserum for aldosterone. This high specificity is largely due to the careful purification of the aldosterone-3-oxime derivative. Using 50% displacement of 1,2-^{3}H-aldosterone as a measure, no other steroid cross-reacts to a degree greater than 0.015% (18-OH-DOC) and most cross-react less than 0.00003%. Recovery, accuracy, and sensitivity are quite satisfactory using only serum extraction with methylene chloride and no further separation. The normal range found is comparable with others reported (3 to 35 ng/100 ml) although women are shown to have more variable levels than men. (auth)

3720 RADIOIMMUNOLOGICAL CHARACTERIZATION OF HUMAN THYROTROPIN AND ITS SUBUNITS: APPLICATIONS FOR THE MEASUREMENT OF HUMAN TSH. Binoux, M.; Pierce, J. C.; Odell, W. D. (Harbor General Hospital, Torrence, CA). J. Clin. Endocrinol. Metab.; 38: No. 4, 674-682(Apr 1974).

Radioimmunological studies were carried out with antisera to the alpha- and beta-subunits of human thyrotropin (hTSH) and to intact hTSH. In the homologous hTSH-α assay (anti-hTSH-α and ^{125}I hTSH-α), immunoreactivity of hCG-α was the same as that of hTSH-α. The dose-response curves of intact hTSH, hLH, hFSH, and hCG, though showing less inhibition than the alpha subunit, were parallel in this assay, thus reflecting structural similarity between the alpha subunit of hTSH and the other glycoprotein hormones. Bovine TSH-α was essentially unreactive in the homologous human alpha assay. In the homologous hTSH-β assay (anti-hTSH-β and ^{125}I hTSH-β), the immunological specificity of the beta subunit was confirmed. Intact hCG and human menopausal gonadotropin did not cross react; however, a low degree of cross reactivity of intact hFSH and intact hLH was observed which may be explained by contamination with small amounts of hTSH. There was a low but definite cross reactivity against bTSH-β in confirmation of studies by double diffusion. No common antigenic sites were detected in the two subunits against either anti-hTSH-α or anti-hTSH-β; the small percent cross reaction of hTSH-α in the beta-unit assay and of hTSH-β in the alpha-unit assay, we concluded was caused by contamination of the β-unit with α-subunit and vice versa. This conclusion is based upon the identity of the hCG-α and hTSH-α in the alpha assay, and their greatly different reactions in the beta assay. From these studies it appears that the conformations or, at least, the immunological determinants of the two subunits available for reaction with antibody are somewhat different than in the intact hormone. Thus, the affinity of intact hTSH and the slope of its reaction compared to hTSH-β were different, both in the homologous anti-hTSH system and the homologous anti-hTSH-β system. Nevertheless, the affinity of hTSH and hTSH-β for hTSH-β antiserum were quite similar if intact hTSH was used as the label. Under these conditions, a specific and sensitive hTSH assay could be developed with antisera to hTSH-β. However, its sensitivity and specificity were not greater than the best homologous hTSH assays reported. (auth)

3721 ALPHA AND BETA SUBUNITS OF HUMAN THYROTRCPIN: PURIFICATION AND DEVELOPMENT OF SPECIFIC RADIOIMMUNOASSAYS. Kourides, I. A.; Weintraub, D.; Levko, M. A.; Maloof, F. (Massachusetts General Hospital, Boston). Endocrinology; 94: No. 5, 1411-1421(May 1974).

Highly purified human TSH (hTSH) was dissociated into its alpha and beta subunits with propionic acid; the subunits were separated from undissociated hTSH and from each other by gel and ion exchange chromatography. During purification hTSH-α was identified by its cross reaction in a radioimmunoassay for the alpha subunit of human chorionic gonadotropin (hCG-α), and hTSH-β was identified by its cross reaction in an hTSH immunoassay. Purified hTSH-α (>90% pure) and hTSH-β (>95% pure) were used to induce antibodies in rabbits by a primary injection of 10 or 15 μg, respectively, followed by 1 to 3 booster injections of 5 μg. Using hTSH-α tracer and anti-hTSH-α from each of 3 rabbits, radioimmunoassays were developed capable of detecting about 1 ng/ml hTSH-α. In these hTSH-α assays, the cross reactivity of hCG-α and hLH-α was virtually complete, while the cross reactivity of hLH was 15% and the reactivity of hTSH, hTSH-β, and hCG was less than 5%. Using hTSH-β tracer and anti-hTSH-β from each of 3 rabbits, radioimmunoassays were developed capable of detecting 0.025-0.25 ng/ml hTSH-β. Two of these immunoassays displayed conventional decreased binding of tracer with increments of unlabeled hTSH-β, while one showed paradoxical enhanced binding. In these hTSH-β assays, hTSH, hTSH-α, hCG, hCG-α, hCG-β, hLH, and hLH-β displayed cross reactivity of 1% or less. The development of hTSH subunit radioimmunoassays provides additional information about the immunologic relationships of glycoprotein hormones and permits measurement of free subunit concentrations in certain unfractionated human sera. (auth)

3722 MEASUREMENT OF PROLACTIN IN MILK BY RADIOIMMUNOASSAY. Malven, P. V.; McMurtry, J. P. (Purdue Univ., Lafayette, IN). J. Dairy Sci.; 57: No. 4, 411-415(Apr 1974).

Double-antibody radioimmunoassay procedures previously developed for measuring prolactin in blood plasma were used for prolactin measurements in milk. Substantial quantities of immunoreactive prolactin were in milk from cows, goats, and sheep. Milk from all three species produced assay responses qualitatively similar to those produced by standard bovine prolactin (i.e., parallel inhibition curves). While prolactin concentrations varied considerably between individual milk samples, those in cow and goat milk were substantially less than reported for rat milk. Samples of milk from all species, except cows, could be frozen and stored without appreciable decreases in prolactin. An additional validation for radioimmunoassay to measure prolactin in milk was from results of a series of in vitro experiments: (a) rat milk and cow milk each crossreacted in the heterologous radioimmunoassay for the hormone of the opposite species only slightly more than would be predicted from their content of native prolactin as measured by homologous assay; (b) cow milk did not significantly affect the final precipitation step in the assay; (c) incubation of iodine-131 labeled prolactin with 50 μl cow milk

under assay conditions did not decrease appreciably its binding to excess anti-prolactin. Incubation with 100 and 200 µl milk did decrease binding enough to result in erroneous overestimations of prolactin concentration. None of these in vitro experiments provided results that invalidated either the experimental finding of substantial prolactin in milk or accurate quantification of the hormone. (auth)

3723 USE OF ^{131}I FOR DETERMINATION OF THE INFUSED ZONE IN CHEMOTHERAPY OF THE MAMMARY GLAND CANCER. Korsunskii, V. N.; Lazichev, Yu. D. (Inst. of Oncology, Moscow). Vop. Onkol.; 20: No. 2, 11-16(1974). (In Russian).

A method of scanning with the human protein serum macroaggregate labelled with ^{131}I was used tc check the position of a catheter in infusion therapy of locally spreading cancer of the mammary gland in 20 patients. Radioisotope study of the infused zone was found to be rather valuable. This method was compared with angiography, the fluoresceine, and indigo carmine tests. This method was employed in patients in whom the injection of an x-ray contrast matter was contraindicated. In addition to an angiographic picture scannograms gave evidences on the state of the capillary flow in the infused zone. (auth)

3724 RADIOIMMUNOASSAY FOR HORMONE. Baba, S.; Kawaguchi, H. (Kobe Univ., Japan). Rinsho Meneki; 5: No. 3, 255-261(Mar 1973). (In Japanese).

This is a summary of radioimmunoassay of hormones in the blood, with special reference to the literature from 1960 to 1972. First, the general principles of radioimmunoassay were stated. Radioimmunoassay was then divided into three categories according to the measurement technique: bound and free tracers simultaneous division and separation method; free tracer separation method; and bound tracer separation method. The characteristics of each were described. The bound tracer separation method differs from the principle of previous assay systems in using a solid-phase radio-immunoassay with standardized and simplified back-titration and measurement method. It is difficult to decide which measurement method is the best, since each method has its own characteristics. Therefore, the measurement method should be decided according to the purpose of its use. The direct radioimmunoassay of proinsulin was then discussed using a recently developed measurement method which employs a small amount of protein by bacteriophage, renin quantitative analysis, and insulin specific protein (I.S.P.) extracted from rat muscle. We found that the activity in the muscle of rat, rabbit, and pig differed from each other, according to investigations of I.S.P. characteristics using the Brush method. One problem in improving the radioimmunoassay was the interference of antibodies produced in the blood. In order to apply this method to routine clinical examinations, the PEG extraction method was considered to be excellent. (JA)

3725 LOCALIZATION OF A METASTATIC ADRENAL CARCINOMA USING ^{131}I-19-IODOCHOLESTEROL. Forman, B. H.; Antar, M. A.; Touloukian, R. J.; Mulrow, P. J.; Genel, M. (Yale Univ., New Haven). J. Nucl. Med.; 15: No. 5, 332-334(May 1974).

Radioactive iodocholesterol was administered to a patient with proven adrenal carcinoma, and serial abdominal scans were performed. The scan after 7 days revealed a large area of increased activity in the region of his previous adrenalectomy as well as other smaller areas suggestive of metastases. These findings correlated well with subsequent arteriography. (auth)

3726 USE OF ^{131}I-CEA ANTIBODY AS A TUMOR SCANNING AGENT. Hoffer, P. B.; Lathrop, K.; Bekerman, C.; Fang, V. S.; Refetoff, S. (Univ. of Chicago). J. Nucl. Med.; 15: No. 5, 323-327(May 1974).

Tumor scanning can be accomplished successfully in an animal model by the use of radioiodinated antibodies specific for the carcinoembryonic antigen produced by the tumor. In this tumor model (GW-39), the radiolabeled antibodies showed tumor localization superior to that of ^{111}In-bleomycin, ^{67}Ga-citrate, and control ^{131}I-labeled normal IgG. Although ^{111}In-bleomycin did show a relatively high tumor uptake, tumor-to-intestine and tumor-to-liver ratios for this agent were approximately 1:1. Relatively slow clearance of blood background (presumably due to incidental labeling of nonspecific IgG) produces a long delay before optimal tumor-to-background ratios are achieved. For this reason, further purification of specific CEA antibodies would be desirable. Efforts are currently under way to apply the above findings to the identification of tumors in human subjects. (auth)

3727 SERUM ALPHA-FETOPROTEIN AND ^{67}Ga CITRATE UPTAKE IN HEPATOMA. Suzuki, T.; Matsumoto, Y.; Manabe, T.; Honjo, I.; Hamamoto, K.; Torizuka, K. (Kyoto Univ.). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 120: No. 3, 627-633(Mar 1974).

Scintiphotography with ^{67}Ga citrate and assay of serum alpha-fetoprotein (AFP) by the Ouchterlony and Mancini methods was performed on 71 patients with carcinoma of the liver (27 hepatomas, 5 cholangiomas and 39 metastatic carcinomas of the liver). Serum AFP was detected in 17 of the patients with hepatoma. Increased uptake of ^{67}Ga citrate was noted in hepatomas, in which greater uptakes were revealed in AFP negative, than in AFP positive cases. The patients with cholangioma and metastatic carcinoma of the liver did not show a high degree of ^{67}Ga uptake, but 2 with metastatic carcinoma showed a slightly increased uptake of the isotope. No significant difference was found in the degree of ^{67}Ga concentration in hepatomas in livers with and without cirrhosis. The conclusion is that scintiphotography with ^{67}Ga citrate is a useful screening method for hepatomas, which cannot be identified by the AFP test. (auth)

3728 COMPUTER DATA HANDLING FOR THE RADIOCHEMICAL IMMUNOASSAY OF INSULIN. Ayrey, G.; Evans, K. L. (London Univ.). pp 303-311 of Liquid Scintillation Counting. Vol. 2. Crook, M. A. (Ed.). London; Heydens and Son Ltd. (1972).

From symposium on liquid scintillation counting; Brighton, UK (13 Sep 1971). See CONF-710991-P2.

It has been demonstrated that use of a computer can greatly speed calculation of results for insulin immunoassay. Consideration of the calibration function has shown that although it is possible to obtain a good approximation to the conventional calibration curve by a linear between points approximation, a more satisfactory procedure involves a least-squares approximation for the best straight line in a plot of C_0/C_1 against insulin concentration. Data handling by digital computer also improves reliability by reducing possible errors due to operator prejudice or fallibility. (LK)

3729 NASOGASTRIC SUCTION TO IMPROVE GASTROINTESTINAL SCANNING. Polga, J. P. (Bethesda Lutheran Hospital, St. Paul). J. Nucl. Med.; 15: No. 5, 374(May 1974).

The validity of gastrointestinal imaging with ^{99m}Tc-pertechnetate has been improved by preparatory nasogastric suction. (auth)

3730 SUBTRACTION TECHNIQUE FOR THE DETECTION OF SUBPHRENIC ABSCESSES USING ^{67}Ga AND ^{99m}Tc. Bethn, R. M.; Damron, J. R.; Hafner, T. (Veterans Administration Hospital, Lexington, KY). J. Nucl. Med.; 15: No. 5, 371-373 (May 1974).

Gallium-67 has been found to localize in inflammatory lesions as well as in liver and spleen. Positive detection of suspected subphrenic abscesses remains a difficult clinical diagnostic problem. The present publication introduces the detection of subphrenic abscesses with ^{67}Ga using a modern scanner subtraction technique with ^{99m}Tc. Patients with clinical symptomatology of a subphrenic abscess and positive correlated roentgenologic findings were scanned at 30 h following an i.v. injection (35 µCi/kg) of ^{67}Ga-citrate. Fifteen minutes prior to the 30-h scan, 2 mCi of ^{99m}Tc-sulfur colloid and human albumin microspheres were injected intravenously. A dual 5-in. total-body rectilinear scanner with dual pulse-height analyzer (PHA) subtraction was used in this study. One pulse-height analyzer (A) was energy calibrated for the 184-and 300-keV gamma rays of ^{67}Ga. The second pulse-height analyzer (B) was calibrated for the ^{99m}Tc 140-keV gamma ray. When the (B) PHA output was subtracted from the (A) PHA output, a subtraction photoscan resulted. The elimination of liver, spleen, and lung due to the ^{99m}Tc content enhanced the ^{67}Ga uptake in subphrenic abscesses. The results of this preliminary report indicate the usefulness of ^{67}Ga and ^{99m}Tc in combination with the subtraction technique as an important aid in the diagnosis of subphrenic abscesses. (auth)

3731 BRAIN SCAN ABNORMALITIES PRODUCED BY ELECTROENCEPHALOGRAPHIC PROCEDURES. Burt, R. W. (Indiana Univ., Indianapolis). J. Nucl. Med.; 15: No. 5, 369-370(May 1974).

Brain scintiphotographic abnormalities may be produced by minor scalp manipulation. The interpreter must be aware that even trivial trauma may cause error in interpretation. (auth)

3732 RENAL COLLOID LOCALIZATION. Coleman, R. E. (Washington Univ., St. Louis). J. Nucl. Med.; 15: No. 5, 367-368 (May 1974).

Renal uptake of ^{99m}Tc-sulfur colloid was observed in a patient with cardiac failure, pleural effusion, and ascites. Colloid labeled with ^{113m}In gave similar results. (auth)

3733 POSITIVE INTESTINAL SCAN CAUSED BY CARCINOID TUMOR. Polga, J. P.; Sargent, J.; Dickinson, P. (Bethesda Lutheran Hospital, St. Paul). J. Nucl. Med.; 15: No. 5, 365-366(May 1974).

The first case of a positive gastrointestinal scan caused by a carcinoid tumor of the ileum is reported. The precise reason

for the concentration of activity of the ^{99m}Tc-pertechnetate is unclear. Repeat imaging 14 days postoperatively was normal. (auth)

3734 UNUSUAL VARIANT IN CEREBRAL CIRCULATION STUDIES. Friedman, B. H.; Lovegrove, F. T. A.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 15: No. 5, 363-364(May 1974).

Early filling of intracranial venous channels during cerebral circulation studies was attributed to jugular vein reflex of the injected material, perhaps related to the patient's breath holding. Scans were performed using ^{99m}Tc-pertechnetate. (ERB)

3735 PERFUSION STUDIES IN THE DIAGNOSIS OF CEREBRAL ANEURYSMS. DeLand, F. H.; Garcia, F. (Univ. of Florida, Gainesville). J. Nucl. Med.; 15: No. 5, 358-360(May 1974).

A dynamic perfusion study identified two aneurysms of the carotid arteries that had been interpreted as a single midline neoplasm in the static images obtained earlier. (auth)

3736 INTRAHEPATIC FOCAL LESION IN ACUTE VIRAL HEPATITIS. Beauchamp, J. M.; Belanger, M. A.; Neitzschman, H. R. (Charity Hospital of Louisiana, New Orleans). J. Nucl. Med.; 15: No. 5, 356-357(May 1974).

A case of viral hepatitis exhibiting a large focal defect on rectilinear scanning with ^{99m}Tc-sulfur colloid which showed a positive localization of ^{75}Se-selenomethionine was recently described. This report presents a similar patient in whom a positive localization with ^{67}Ga-citrate was noted. As in the previously described case, the lesion was initially thought to represent a space-occupying mass rather than diffuse inflammatory process. (auth)

3737 AUTOMATED SYSTEM FOR MEASUREMENT OF LEUKOCYTE METABOLISM. Amrein, P. C.; Larson, S. M.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 15: No. 5, 352-355(May 1974).

The hexose monophosphate shunt by which 1-^{14}C-glucose is converted to $^{14}CO_2$ is stimulated by phagocytosis. An automated system that permits quantification of this phenomenon in 25 samples was developed and automated. Polymorphonuclear leukocytes were suspended in a balanced salt solution containing 1-^{14}C-glucose and placed in a sterile sampling vial. Incubation at 37°C was terminated by citric acid addition at 90 min. Sampling was performed automatically in an instrument that aspirates the atmosphere of each vial into an ion chamber for measurement. Siliconization of the sample vials greatly reduced the basal metabolism of the white cell suspensions. Terminating the incubation with citric acid increased $^{14}CO_2$ production by about 50%. Agitation during incubation was found to be of no value. There was a direct relationship between $^{14}CO_2$ production and both the number of leukocytes and the log of the antigen concentration. During phagocytosis, there was a peak in $^{14}CO_2$ production about 90 min after the addition of particles to the white cell suspension. (auth)

3738 BLEOMYCIN AS A ^{99m}Tc CARRIER IN TUMOR VISUALIZATION. Lin, M. S.; Goodwin, D. A.; Kruse, S. L. (Veterans Administration Hospital, Palo Alto, CA). J. Nucl. Med.; 15: No. 5, 338-342(May 1974).

The oncostatic polypeptide drug, bleomycin, was evaluated as a potential carrier of ^{99m}Tc for scintigraphic visualization of malignant tumors. The drug was labeled with ^{99m}Tc by a tin(II) method. Paper chromatographic analysis showed that most technetium in the preparation migrated similarly as bleomycin. Following intravenous administration of the ^{99m}Tc-bleomycin, the blood technetium decreased to about 10% dose after 6 h in cancer patients. In mice bearing a transplanted carcinoma, the tumor/blood concentration ratio of the technetium reached nearly 3 after 6 h. Scintigraphy was performed using a rectilinear scanner after 2 to 4 h and/or a scintillation camera after 0.5 to 6 h following the administration in 18 cancer patients each with one biopsy-proven malignant lesion. Squamous-cell lesions of about 3 cm or less in the throat or the neck constituted 7 of the 18 lesions. Four of the seven were visualized. Ten lesions were in the chest and consisted of a Hodgkin's granuloma, a seminoma, four adenocarcinomas, and four squamous-cell carcinoma lesions. The granuloma, the seminoma, a bronchogenic adenocarcinoma, and two squamous-cell carcinoma lesions were visualized. Generally, whether in the throat and neck or in the chest, visualized lesions were relatively large or superficially located. (auth)

3739 USE OF ^{244}Cm AND ^{145}Pm AS SOURCES FOR BONE MINERALIZATION STUDIES. Friedman, A. M.; Oltman, B. G.; Kastner, J.; Eckerman, K. F.; Goodman, L. S. (Argonne National Lab., IL). J. Nucl. Med.; 15: No. 5, 335-337(May 1974).

Both the 17.6-year ^{244}Cm and the 17.7-year ^{145}Pm are useful x-ray sources for bone mineral determination in vivo and in vitro. Their long half-lives also make them much more convenient than 60-day ^{125}I. (auth)

3740 EXTRAOSSEOUS TUMOR UPTAKE OF ^{85}Sr AND ^{67}Ga. Yeh, E. L. (Wood Veterans Administration Center, Milwaukee). J. Nucl. Med.; 15: No. 5, 361-362(May 1974).

Uptake of ^{85}Sr in extraosseous malignant tumors without calcification was observed in two cases. The mechanism is unknown. Gallium-67 and ^{87m}Sr have been used for detection of the tumor. Similar tumor uptakes of ^{85}Sr and ^{67}Ga were seen in one patient but tumor uptake of ^{85}Sr and not ^{67}Ga was observed in the other. This finding suggests that a different mechanism may be involved in the extraosseous malignant tumor uptakes of ^{85}Sr and ^{67}Ga. (auth)

3741 DIAGNOSTIC APPLICATIONS OF RADIOPERTECHNETATE AND RADIOHIPPURATE IMAGING IN POST-RENAL TRANSPLANT COMPLICATIONS. Rosenthall, L.; Mangel, R.; Lisbona, R.; Lacourciere, Y. (Montreal General Hospital). Radiology; 111: No. 2, 347-358(May 1974).

Radiopertechnetate and radiohippurate imaging offer a noninvasive method of distinguishing between various complications of renal transplantation. They are especially useful in patients on dialysis, may anticipate biochemical changes by as much as 48 hours, and also provide a useful independent means of confirming the biochemical and clinical parameters. The potential hazards of angiography and retrograde ureteral catheterization are eliminated. (auth)

3742 DIRECT AND INDIRECT RADIONUCLIDE CYSTOGRAPHY. Conway, J. J.; Belman, A. B.; King, L. R. (Northwestern Univ., Chicago). Semin. Nucl. Med.; 4: No. 2, 197-211(Apr 1974).

Direct radionuclide cystography has proved to be a useful substitute for roentgenological cystography in studying patients with vesicoureteral reflux. Although the initial diagnosis generally is made with x ray, serial follow-up examinations are more feasible with the radionuclide method because of its lower radiation burden. Additional information obtainable from these studies includes determinations of bladder volume at time of reflux, calculation of urine volume that has refluxed as well as residual bladder urine volume quantification of reflux drainage time from the upper tracts, and visualization of anatomic defects and variants. More recently, indirect nuclear cystography has been evaluated for the detection of reflux. The greater degree of patient cooperation required for this procedure would appear to favor its usefulness in older children. More investigative work, including correlation with direct radionuclide cystography as well as the roentgenologic studies, is needed. (auth)

3743 VALUE OF RADIONUCLIDE STUDIES TO THE PRACTICING UROLOGIST AND NEPHROLOGIST. Schlegel, J. U. (Tulane Univ., New Orleans). Semin. Nucl. Med.; 4: No. 2, 213-216(Apr 1974).

The use of ^{131}I-hippuran and ^{99m}Tc-labelled compounds in the study of kidney function and morphology is of tremendous value to the urologist and the nephrologist. However, convincing the specialist that he should make use of these radionuclide techniques is sometimes difficult. (EBB)

3744 HAZARDS IN INTERPRETATION OF XENON WASHOUT STUDIES OF THE CANINE KIDNEY. Shanser, J. D.; Korobkin, M.; Seidlitz, L.; Carlson, E. L.; Shames, D. M. (Univ. of California, San Francisco). Radiology; 111: No. 2, 461-463(May 1974).

Reduction in renal artery perfusion pressure in dogs resulted in a xenon washout curve that suggested loss of the rapid component thought to represent cortical flood flow. Correlation studies using renal arteriography and intrarenal distribution of labeled microspheres indicated a uniform reduction of flow to all renal compartments with no redistribution of flow away from the cortex. Exponential components of the xenon washout curve should not be assigned specific intrarenal compartments without independent supporting validation. (auth)

3745 RENAL ACCUMULATION OF ^{99m}Tc SULFUR COLLOID IN TRANSPLANT REJECTION. Solaric-George, E. A.; Fletcher, J. W.; Newton, W. T.; Henry, R. E.; Donati, R. M. (St. Louis Veterans Administration Hospital). Radiology; 111: No. 2, 465-466(May 1974).

Scintiphotographic visualization of renal transplant accumulation of ^{99m}Tc-sulfur colloid was evaluated in 21 patients with renal transplants. Forty-one examinations were performed comparing transplant activity with bone-marrow activity and clinical or pathological diagnosis. A marked degree of transplant radiocolloid accumulation was seen in chronic rejection. Patients with normal transplant function, acute rejection, or acute tubular necrosis presented with slight or absent transplant radioactivity. (auth)

3746 RADIONUCLIDE ANGIOGRAM IN COMBINATION WITH BARIUM–SULFATE–^{99m}Tc-PERTECHNETATE MIXTURE. Gallow, G.; Kassner, E. G.; Solomon, N.; Rabinowitz, J. G. (State Univ. of New York, Brooklyn). Radiology; 111: No. 2, 481–482 (May 1974).

^{99m}Tc-pertechnetate angiocardiography performed simultaneously with radionuclide esophagography (barium-sulfate-^{99m}Tc-pertechnetate mixture) was used to rule out a mediastinal mass in a child with known congenital heart disease. The mass proved to be the left atrium. This technique is useful in evaluating the cardiac silhouette as well as mediastinal masses. (auth)

3747 RADIOTECHNETIUM RENOGRAPHY AND SERIAL RADIOHIPPURATE IMAGING FOR SCREENING RENOVASCULAR HYPERTENSION. Rosenthall, L. (Montreal General Hospital). Semin. Nucl. Med.; 4: No. 2, 97-116(Apr 1974).

A radionuclide approach to screening renal disease in general and renovascular hypertension in particular is detailed. It consists of either a Hg-chlormerodrin scan, radiopertechnetate perfusion, and serial 3-min-exposure ^{131}I-hippurate images or serial 3-min ^{131}-hippurate images followed by ^{99m}Tc-glucoheptonate (or equivalent) perfusion and static scans. The radiotechnetium perfusion studies are recorded by a data processor, and time-activity histograms are generated on playback for analysis of the transit through the kidneys and systemic circulation. This technique has been considerably more sensitive than rapid-sequence hypertensive intravenous pyelograms and more sensitive and informative than the conventional ^{131}I-hippurate renogram utilizing paired external scintillation detectors. Correlation with contrast arteriography and remedial surgery has been excellent. A spectrum of renal afflictions and the relative attributes of the radiopharmaceuticals used in their investigation are illustrated. (auth)

3748 TRAUMATIC INJURIES OF THE RENAL VASCULATURE AND PARENCHYMA. Koenigsberg, M.; Blaufox, M. D.; Freeman, L. M. (Albert Einstein Coll. of Medicine, Bronx, NY). Semin. Nucl. Med.; 4: No. 2, 117-132(Apr 1974).

Renal injuries may be classified according to their severity as minor, major, or massive. Roentgenographic and radionuclide investigation are indicated in all patients with gross or microscopic hematuria after trauma. Initial study should include high-dose infusion urography and static renal scintigraphy. If both examinations are within normal limits, no further workup may be necessary. When no contrast medium appears in the kidney during urography, a radiopertechnetate flow study is indicated. Absence of kidney activity during this study is compatible with major arterial occlusion, and prompt angiographic examination should be performed. Segmental areas of impaired visualization on the urogram or of diminished activity on the scintigram in the region of the kidney may represent minor contusion or major injury such as infarct. If the patient's condition is stable and if surgery is not contemplated, angiography may be delayed and possibly omitted. The differentiation between major and minor injury can be made by follow-up nuclide imaging studies. Infarcts remain with persistent defects in the renal image, while contusions demonstrate a return to normal pattern over a period of several weeks. If the patient is unstable, prompt angiographic study may be necessary for immediate definitive diagnosis. Angiography is particularly valuable in rapidly evaluating a patient with intra-abdominal injuries thought to involve more than one organ. Radionuclide and roentgenographic studies of renal trauma have correlated well in previous studies. When the radionuclide study has been normal, no significant injuries have been observed at subsequent angiographic examination. Because of their safety and ease of performance, radionuclide techniques are of great value in these cases, particularly for serial follow-up studies. (auth)

3749 SPACE-OCCUPYING LESIONS OF THE KIDNEY. Morales, J. O. (Episcopal Hospital, Philadelphia). Semin. Nucl. Med.; 4: No. 2, 133-149(Apr 1974).

Renal imaging is a useful procedure for the evaluation of suspected space-occupying lesions provided it is done as part of a logical approach to the problem. Its major contributions are in excluding tumors when lesions 2.5 cm in diameter or larger are suspected from the intravenous urogram and in studying the vascularity of a known lesion. For the former purpose the agent of choice would be ^{99m}Tc-iron ascorbate DTPA (Renotec) because of the higher count rate, smaller radiation dose, and less photon attenuation than with ^{197}Hg-chlormerodrin. The initial static view should be done with ^{197}Hg-chlormerodrin when evaluating the vascularity of a lesion so as not to interfere with the detection of the imaging agent for the dynamic study—^{99m}Tc-pertechnetate or ^{99m}Tc-Sn DTPA. When there is obvious evidence of a space-occupying lesion in the I.V.U. or in the initial static image, an ultrasound study should be done next. If a cystic pattern is found, renal imaging is unnecessary, since it cannot distinguish between a cyst, an abscess, and an avascular solid tumor. If ultrasound cannot be done or if its pattern is noncystic, static and dynamic imaging are indicated, since the procedures are simple and complication-free and can be done on an outpatient basis. If blood flow is seen within a defect detected in the static image, a neoplasm can be diagnosed with practically absolute certainty. Since it is extremely rare to find a space-occupying lesion by radionuclide imaging that cannot be found by a properly done I.V.U., and since lesions of less than 2.5 cm are frequently missed on scintigrams, the I.V.U. should be done first in cases of clinically suspected space-occupying lesions. (auth)

3750 RADIOLABELED CHELATES FOR VISUALIZATION OF KIDNEY FUNCTION AND STRUCTURE WITH EMPHASIS ON THEIR USE IN RENAL INSUFFICIENCY. Reba, R. C.; Poulose, K. P.; Kirchner, P. T. (Washington Hospital Center, DC). Semin. Nucl. Med.; 4: No. 2, 151-168(Apr 1974).

Stable chelates of indium-111, indium-113m, chromium-51, ytterbium-169, and technetium-99m have proved to be useful radiopharmaceuticals for the evaluation of renal structure and function. In their pure forms, all of these materials are handled by glomerular filtration and may be used to determine GFR. Correlation with inulin clearance studies has been quite good. ^{99m}Tc-labeled DTPA is ideally suited for renal imaging studies with the Anger scintillation camera. Images obtained within the first minute after intravenous injection of a bolus visualize the aorta and relative vascular supply to each kidney. A study at 2 min defines the morphology, and subsequent serial 5-min scintiphotos outline the excretory pathways. The radioactive chelates have a high degree of success in visualizing the kidneys in patients with severe renal insufficiency. ^{197}Hg-chlormerodrin is primarily extracted by the liver in such patients, thereby failing to visualize the kidneys. In direct comparisons with the chelates, radioiodinated Hippuran appears to be more sensitive in detecting function in many azotemic patients. Other applications of renal imaging studies with radiochelates include the detection of unilateral renal disease and obstructive uropathy, the differentiation of cysts and tumors, and the evaluation of function after renal transplantation. (auth)

3751 APPLICATIONS OF RADIONUCLIDES IN RENAL TRANSPLANTATION. zum Winkel, K.; Harbst, H.; Das, K. B.; Newiger, T. (Freie Univ., Berlin). Semin. Nucl. Med.; 4: No. 2, 169-186(Apr 1974).

The increasing frequency of renal transplantation has stimulated the development of diagnostic methods of evaluating the functional integrity of the graft. Radionuclide techniques have achieved great popularity in this regard. Although clearance studies, fibrinogen uptake, and conventional probe renography have been used with success, the imaging studies of the kidney recently have been of particular interest. Sequential scintiphotography with ^{131}I-Hippuran has been shown to facilitate the diagnosis of problems such as vascular thrombosis, acute tubular necrosis, acute and chronic rejection, urinary extravasation, and ureteral obstruction. Although the appearance of the kidney in any one study may be diagnostic, it is of much greater value to observe improvement or deterioration of function studies with bolus injections of ^{99m}Tc-pertechnetate to establish the patency of the newly anastomosed vascular pathways. (auth)

3752 COMPARISON OF HEART CHAMBER AND PULMONARY DILUTION CURVES FOR THE DIAGNOSIS OF CARDIAC SHUNTS. Greenfield, L. D.; Bennett, L. R. (Univ. of California, Los Angeles). Contract AT(04-1)GEN-12. Radiology; 111: No. 2, 359-363(May 1974).

Heart chamber and pulmonary dilution curves were used to diagnose intracardiac and extracardiac shunts in 46 patients. Pulmonary dilution curves, as measured by C_2/C_1 ratios, could separate normal patients from those with intracardiac or extracardiac shunts, but patients with right-to-left and left-to-right shunts had similar C_2/C_1 values. Heart chamber dilution curves not only diagnosed left-to-right, right-to-left, and bidirectional intracardiac shunts but located the shunt at the atrial or ventricular level. Among 33 patients with shunts, the condition was diagnosed by heart curves in 19 and by pulmonary curves in 25. (auth)

3753 NORMAL BONE RADIONUCLIDE IMAGE WITH DIFFUSE SKELETAL LYMPHOMA. Frankel, R. S.; Johnson, K. W.; Mabry, J. J.; Johnston, J. S. (National Cancer Inst., Bethesda, MD). Radiology; 111: No. 2, 365-366(May 1974).

A case of diffuse skeletal involvement by lymphoma is presented. Bone scan was interpreted as normal, but gallium scans and roentgenograms revealed the proper diagnosis. A possible explanation for this discrepancy is offered. (auth)

3754 HUMAN PROLACTIN: ITS PURIFICATION AND RADIOIMMUNOASSAY WITH APPLICATIONS TO PHYSIOLOGY AND MEDICINE. Hwang, P. L. H. Montreal; McGill Univ. (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Prolactin was purified from human pituitary glands with a yield of 50 μg/gland. The purified product was equipotent with highly purified sheep prolactin in bioassay (30.5 IU/mg) and was sufficiently pure for amino acid sequence analysis, which revealed a striking homology between human and sheep prolactin. Human prolactin has also been partially purified from amniotic fluid. A specific radioimmunoassay for human prolactin has been developed to measure circulating prolactin concentrations in man. In normal adults, serum prolactin levels usually remained below 30 ng/ml, being slightly higher in females than in males. Serum prolactin concentrations were elevated in the newborn, in pregnant and lactating women, and in most cases of galactorrhea, but not in patients with breast cancer or acromegaly. Chlorpromazine and thyrotropin releasing hormone increased while L-DOPA decreased serum prolactin; these agents may prove useful in evaluating hypothalamic-pituitary function or in treating conditions associated with abnormal prolactin secretion. (Diss. Abstr. Int., B)

3755 ESTIMATION OF TOTAL BODY POTASSIUM IN NORMAL ADOLESCENTS BY WHOLE-BODY COUNTING: AGE AND SEX DIFFERENCES. Novak, L. P.; Tauxe, W. N.; Orvis, A. L. (Mayo Clinic, Rochester, MN). Med. Sci. Sports; 5: No. 3, 147-155(Fall 1973).

Total body potassium, fat-free mass, and body cell mass supported by anthropometrical appraisal of leanness-fatness were determined in 111 randomly selected adolescent boys and in 100 randomly selected adolescent girls. Statistical analysis of age and sex differences revealed that, in early adolescence, boys gained total body potassium, fat-free mass, and cellular mass, with a concomitant decrease of body fat, except at the ages of 12 and 13 years. At 11 and 12 years of age, the body composition of boys and girls was alike; but after that the girls' percentages of fat-free mass and body cell mass decreased with age and body fat increased. Anthropometrical appraisal of corrected diameters and volumes of the limbs supported interpretations of results obtained from total body potassium. (auth)

3756 MODIFIED METHOD FOR THE DETERMINATION OF CIRCULATING PLASMA VOLUME BY ^{131}I-RISA. Calibration with Mock-Iodine. Motohara, S. (Kyoto Univ.); Saito, M.; Suzuki, M. Kaku Igaku; 10: No. 6, 565-569(Dec 1973). (In Japanese).

Circulating plasma volume (CPV) or blood volume is one of important circulatory parameters that reflect the cardiovascular abnormality. Various techniques were reported for the determination, among which the dilution method with nondiffusible radioisotope (^{131}I-RISA) was presumed to be the best one. Modification of the method, using mock-iodine capsules for the calibration is described. Two mock-iodine capsules were prepared: one has radioactivity of about 50 μCi (large-dose MI), and the other less than 0.1 μCi (small-dose MI). These activities roughly correspond with those of injected RISA and of 1 ml of plasma, respectively. Circulating plasma volume can be determined by the following equation: CPV = Ps/Pw × Mw/Ms × k × f(t) × 1000 (1) where Ps; net activity of RISA injected to a patient. Pw; activity of RISA in 1 ml of plasma. Ms; activity of large-dose MI. Mw; activity of small-dose MI. k; a constant determined by the equation (2). t; time elapsed since the measurement of Ps to Pw. f(t); decay rate of ^{131}I in t hour. Determination of k is made from equation (2) by making several 1000 ml-standard solutions. k = Sw/Ss × Ms/Mw × 1/f(t) (2) where Ss; net activity of RISA used for the preparation of 1000 ml standard solutions. Sw; activity of RISA in 1 ml of standard solution. t; time elapsed since the measurement of Ss to Sw. Once k is determined accurately, the same k value can be used in equation (1), and there is no need to prepare standard solutions thereafter. The value of k determined from seven standard solutions in our laboratory was 0.5777 ± 0.0047 (mean ± SD). Seventeen solutions of RISA were prepared in three different sizes of flask (1000 ml, 2000 ml and 3000 ml), and their volumes were calculated from equation (1). Calculated volumes showed very close agreement with flask volumes, and mean ± standard deviation of calculated volume/flask volume was 0.998 ± 0.010. (auth)

3757 RADIOIODINATED SOLUBLE HL-A ANTIGENS: HL-A ALLOANTIGENIC CHARACTERIZATION AND USE IN RADIOIMMUNOASSAY. Tanigaki, N.; Miyakawa, Y.; Yagi, Y.; Kreiter, V. P.; Pressman, D. (Roswell Park Memorial Inst., Buffalo). J. Immunol. Methods; 3: 109-125(Oct 1973).

A method is described for the quantitative radioimmunoassay of HL-A antigens which is based on the degree of inhibition of the direct binding of radiolabeled soluble HL-A antigen and its alloantibody by the sample to be assayed. The assay is easily carried out, the results are highly quantitative and reproducible. The method can be applied to the quantitation of HL-A antigens in the insoluble form including those on intact cells as well as in the soluble form. The method has an advantage over the cytotoxic method since it does not require viable cells and complement for the primary test system. The radiolabeled HL-A antigens are prepared by radioiodinating purified, soluble HL-A antigens isolated from human lymphoid cells in long-term culture. The radiolabeled HL-A antigens show high binding activities with the corresponding alloantisera. The degree of binding is determined by precipitating the radioactive HL-A antigen–alloantibody complex with goat anti-human IgG antibody, i.e., the double antibody technique. (auth)

3758 IN VITRO INDUCTION OF TUMOR SPECIFIC IMMUNITY: REQUIREMENTS FOR T LYMPHOCYTES AND TUMOR GROWTH INHIBITION IN VIVO. Roellinghoff, M.; Wagner, H. (Inst. of Medical Research, Melbourne). Eur. J. Immunol.; 3: 471-476(Aug 1973).

Cortisone-resistant thymocytes, spleen cells, thoracic duct lymphocytes, peritoneal exudate cells and peripheral blood lymphocytes of BALB/c mice were immunized in vitro against syngeneic HPC-108 plasma cell tumor cells. Cocultivation of spleen lymphocytes together with HPC-108 cells generated the highest cytotoxic immune response in comparison to other lymphocyte sources. Cytotoxicity was tested in a 6 hour ^{51}Cr release assay using HPC-108 cells as target cells. The use of AKR anti-Θ C3H serum indicated that thymus-derived (T) lymphocytes are essential to the initiation phase of the immune response to plasma cell tumor cells. Furthermore, evidence is presented that the cytotoxic effector cells in the in vitro tumor immune response are T lymphocytes. Spleen cells activated in vitro against HPC-108 tumor cells were shown to specifically prevent tumor growth from simultaneously injected HPC-108 cells in irradiated recipient mice. (auth)

3759 PRESENT STATUS OF NUCLEAR MEDICINE IN JAPAN (1972). III. Radioisotopes Administered to Patients. Kakehi, H.; Saegusa, K.; Uchiyama, G. (Chiba Univ., Japan). Radioisotopes (Tokyo); 22: No. 10, 593-605(Oct 1973). (In Japanese).

The present status of clinical applications of radioisotopes in Japan is reported, on the basis of the results of questionnaires of fiscal 1972. The results of applicable answers collected from 270 facilities were compared with those in fiscal 1965 and 1968. The number of cases of radioisotope administrations per facility was 1066 during the year, which was about twice of that of fiscal 1968. In all the cases of radioisotope administrations, 97.6% was administered for the purpose of diagnosis, while only 2.4% was administered for therapy. Among the nuclides, ^{131}I was used in 50% of all the cases for test and diagnosis and ^{198}Au-colloid was used in 22.5%. Compared with 1968, increases of application of ^{99m}Tc, ^{75}Se, and ^{67}Ga were observed. Radioisotope doses administered to patients per facility averaged 1.240 mCi over the year, which was 2.3 times those of 1968. (JA)

3760 DENERVATION EFFECTS ON NEWT LIMB REGENERATION: AUTORADIOGRAPHY WITH ^{3}H-THYMIDINE. Dresden, M. H. (Baylor Coll., Houston, TX). Cell Differentiation; 2: 255-259(1973).

The effect of denervation on thymidine incorporation in vivo was studied in partially regenerated limbs of the newt, Triturus (Notophthalmus) viridescens. After 41 hr of denervation, incorporation during a 6-hr labeling period in vivo has decreased by 57%. This decrease is accompanied by a quantitatively similar decrease in the number of labeled cells, as measured radioautographically. A differential effect on blastemal cells is observed, suggesting that the nerve trophic function is exerted mainly on this cell type. (auth)

3761 ^{14}C-ASSAY FOR PHOTORESPIRATION IN AQUATIC PLANTS. Hough, R. A.; Wetzel, R. G. (Michigan State Univ., Hickory Corners). Contract AT(11-1)-1599. Plant Physiol.; 49: 987-990(1972).

The ^{14}C-assay developed by Zelitch to evaluate photorespiration was modified for use in submersed aquatic plants in the laboratory and in situ. Results in laboratory cultures of Najas flexilis suggest that photorespiration occurs but is limited in comparison to terrestrial C_3 plants and is related to the rate of diffusion of CO_2 from the plant and to the carrying capacity of water for dissolved oxygen. (auth)

3762 RADIOISOTOPE STUDIES IN DIAGNOSIS OF BONE METASTASES. Kuznetsova, L. B.; Akhmedov, B. P. (Inst. of Experimental and Clinical Oncology, Moscow). Vop. Onkol.; 20: No. 3, 25-30(1974). (In Russian).

An experience with the complex radioisotope study of the skeletal system in 70 oncological patients by means of radioactive strontium (Sr-85) is described. An analysis of the results of the study has evidenced a certain advantage of using this method for an early recognition of bone metastases, for proper estimation of the tumor spread, and a detailed determination of the clinico-roentgenological diagnosis in doubtful cases. (auth)

3763 SCINTIGRAPHIC METHOD FOR DIFFERENTIAL DIAGNOSIS OF SUBDURAL EFFUSIONS. Prevot, H.; Hatger, W.; Walther, H. Radiol. Diagn.; 13: No. 3, 405-411(1972). (In German).

In the diagnosis of subdural effusions the significance of the scintigraphic examination after the subdural injection of ^{131}I-albumin is restricted. Different diseases may produce the same pictures. In order to subdivide the differential diagnosis the serum activity after intrathecal injection of ^{131}I-HSA was measured continuously, thus determining the rate in which the injected activity streamed away into the space of blood. The low number of examinations does not allow a definitive judgement but the results up to now make it probable that technical methods can be used to separate encapsulated subdural effusions from other intracranial accumulations of fluids. (auth)

3764 INFLUENCE OF ANGIOGRAPHY ON THE RENAL CIRCULATION MEASURED WITH ^{133}Xe. Buchali, K.; Zimmermann, H. B.; Strangefeld, D.; Scholz, D.; Schneider, G. (Humboldt Univ., Berlin). Radiol. Diagn.; 13: No. 3, 413-416(1972). (In German).

In 16 patients measurements of renal circulation with ^{133}Xe before and after selective angiography were performed. An increase of the circulation of about 18% was yielded the renal cortex and the marrow being involved. The simultaneously checked isotope nephrographs and creatinin clearances did not show any changes except one single case. For patients with normal and restricted (7 patients) renal function the examinations did not give hints to a different behavior. (auth)

3765 ARTERIOGRAPHIC AND RADIOISOTOPE METHOD IN DIAGNOSIS OF RENAL TUMORS. Klyucharev, B. V.; Kuz'min, V. G. (Inst. of Oncology, Leningrad). Vop. Onkol.; 20: No. 3, 36-40(1974). (In Russian).

A comparative estimation of isotope and arteriographic methods of diagnosis in renal tumors was made. Scannographic focal or total changes indicate a possible neoplasm, but they do not permit to differentiate various pathological processes in the kidney. Renal arteriography is considered to be the most precise method of diagnosis, or when it is necessary to determine the renal tumor spread. (auth)

3766 RADIOASSAY IN CLINICAL MEDICINE. Newton, W. T.; Donati, R. M. (eds.). Springfield, IL; Charles C Thomas, Publishers (1974). 193p. $11.75.

This book is concerned with the techniques and use of radionuclides in the assay of chemical compounds of biological interest. The nine chapters were written by separate authors who have had wide experience in radioassay. Techniques described include: radioimmunoassay; inhibition assays; competitive protein binding assays; and bioassays. Also, individual assays of proteins, peptides, steroids, fatty acids (prostaglandins) and a water soluble vitamin are presented. Specific compounds of clinical interest discussed include prostaglandins, digitalis, thyroid hormones, Vitamin B-12, long-acting thyroid stimulator, and erythropoietin. The presentations in this text are sufficiently detailed to allow the reader to become familiar with the vagaries and limitations to the assay as well as some of the individual requirements that are necessary for success. (CH)

MATERIALS

3767 (N-74-14364) EXAMINATION OF T-111 CLAD URANIUM NITRIDE FUEL PINS IRRADIATED UP TO 13,000 HOURS AT A CLAD TEMPERATURE OF 990°C. Slaby, J. G.; Siegel, B. L. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Dec 1973. 46p. (NASA-TM-X-2950; E-7579). NTIS $3.00.

The examination of 27 fuel pins irradiated for up to 13,000 hours at 990°C is described. The fuel pin clad was a tantalum alloy with uranium nitride as the nuclear fuel. Two nominal fuel pin diameters were tested with a maximum burnup of 2.34 at. %. Twenty-two fuel pins were tested for fission gas leaks; thirteen pins leaked. Clad ductility tests indicated clad embrittlement. The embrittlement is attributed to hydrogen from an (n,p) reaction in the fuel. Fuel swelling was burnup-dependent, and the amount of fission gas release was low, generally less than 0.5%. No incompatibilities between fuel liner and clad were in evidence. (auth)

3768 (UCRL-51466) FILAMENT-WOUND KEVLAR 49/EPOXY PRESSURE VESSELS. Chiao, T. T.; Hamstad, M. A.; Marcon, M. A.; Hanafee, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1973. Contract W-7405-Eng-48. 66p. (NASA-CR-134506). Dep. NTIS $5.45.

The performance of an organic fiber (Kevlar 49) was investigated. The strength of fiber/epoxy strands was studied, with the variables: fiber uniformity, strength distribution at room and LN_2 temperatures, stress–strain characteristics, strain rate effect on the fiber strength, stress-rupture behavior, and ageing under no load. The composite performance in filament-wound pressure vessels was studied, with the variables: spherical vs cylindrical vessels, cylindrical vessel design and size, winding patterns, reproducibility, pressurization rate, fatigue, and effect of liquid hydrogen temperatures. A study was made of the acoustic emission generated during tensile tests of the fiber/epoxy strands, tensile tests of fiber/epoxy elongated NOL rings, burst tests at room temperature of the cylindrical and spherical pressure vessels, and vessel fatigue tests. A microstructural characterization of the failure mode of the fiber was carried out using transmission and scanning electron microscopy and optical microscopy. Fracture surfaces of bare fibers were compared with epoxy-impregnated strands from tensile tests, pressure vessels, and NOL rings. (54 figures) (auth)

3769 DIFFRACTION OF LIGHT BY CYLINDRICAL MAGNETIC DOMAIN ARRAYS IN THIN RARE EARTH GARNET FILMS. Papworth, K. R. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi (a); 22: No. 2, 373-380(16 Apr 1974).

The diffraction of light by magnetic bubble domain arrays in garnet materials is reported. This Frauenhofer diffraction is analyzed using standard diffraction theory, and the experimental observations are all in agreement with this theory. (auth)

Ceramics and Cermets

Refer also to abstracts 2633, 2804, 2825, 3824, 3874, 3875, 4425, 5490, 5615, and 5790.

3770 (BARC/I-205) FISSION PRODUCTS BEHAVIOR IN FUEL MATERIALS. Raj, B.; Sivaramakrishnan, S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 23p. INIS.

Fission products are released in the fuel during reactor operation. The presence of these fission products produces changes in the properties of the fuel. Among the various fission products produced, gaseous ones introduce more problems due to swelling of the fuel etc. The various types of fission products, their production, distribution and their effects on the oxide fuel are reviewed. Though a wider coverage has been given to the fission gases, solid and volatile fission products are also covered. Brief mention is made of the various models put forward to explain fission gas swelling and the experimental techniques employed. (103 references) (auth)

3771 (EURFNR-1123) SINTERING OF UO_2–PuO_2 FUEL PELLETS FOR IRRADIATION EXPERIMENTS. Dippel, T.; Pollanz, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jul 1973. 67p. Dep. NTIS $6.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The fabrication method of uranium–plutonium mixed oxide fuel pellets produced in the Plutonium Laboratory of the Institut für Material-und Festkörperforschung is described. Detailed fabrication data are presented under the title of the irradiation test groups. The influence of various parameters on the fabrication process and the sintered product is discussed. A method for the predetermination of changes in geometry and density is given for pellets made from a well-known powder feed material. (auth)

3772 (FRNC-TH-473) DECAY IN THE FLUORESCENCE OF RADIOPHOTOLUMINESCENT GLASSES. Application to Weak Radiations. Bouvard, G. (Toulouse-3 Univ., 31 (France)). 1973. 101p. (In French). Dep. NTIS (U. S. Sales Only) $8.25.

Thesis.

The decay in the fluorescence of radiophotoluminescent glasses was studied as a function of exposure to ^{60}Co γ radiation; pulse sampling and integration methods were used. A deconvolution program was developed permitting the de-excitation probabilities of excited centers to be obtained. Two decay time constants were observed for a nonirradiated glass (0.7 μs and 150 μs). Irradiation was observed to create centers which deactivate with two principal time constants 0.6 and 4 μs. A relation is proposed between the long time constant and the exposure (10^{-4} at 50R). (FR)

3773 (JUL-1038-HT) FAST NEUTRON FLUX INDUCED CHANGES IN THE MECHANICAL BEHAVIOR OF COATED PARTICLES IN THE HIGH TEMPERATURE REACTOR (HTR). Baier, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Jan 1974. 146p. (In German). Dep. NTIS (US Sales Only) $10.50.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Fast neutron dose limits beyond which mechanical failure of pyrocarbon layers occurs with coated particle fuel are described. The influence of irradiation temperature, layer geometry, and structural parameters in the pyrocarbon on the lifetime of the particles is also described. Irradiation tests in the BR2-Reactor (Mol, Belgium), DFR (Dounreay Fast Reactor, Scotland), FRJ2 (Jülich, German Federal Republic), R2 (Studsvik, Sweden) and in the Dragon Reactor (Winfrith, England) were evaluated and are interpreted. In the experiments a fast neutron dose of more than 20×10^{21} cm^{-2}, E > 0.1 MeV, had been accumulated with temperatures ranging from 600 to 1300°C. The most determining factor on the lifetime of particle coatings is the PyC structure which, however, cannot sufficiently be described by the parameters generally used: density, apparent crystallite size, and anisotropy of orientation. Additional detailed information on manufacture therefore is essential. Particles fail at higher neutron fluence the lower the irradiation temperature. Geometrical factors such as layer sequence and layer thickness are of minor influence. Particles irradiated as loose fail earlier than those pressed into graphite matrix. (auth)

3774 (NAA-SR-5300) TORY-II-A REACTOR PLATE-TYPE FUEL ELEMENT FABRICATION. Rubin, J. A.; Gardner, W. J. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Apr 1961. Contract AT(11-1)-Gen-8. 100p. Dep. NTIS $7.00.

Declassified 27 Nov 1973.

Research directed toward development of BeO–UO_2 fuel material for the Pluto reactor is described. Information is included on coprecipitation of hydrous oxides of Be and U, thermal decomposition of molten salts of U and Be, mechanical mixing of oxides of Be and U and additional oxides, and wet mixing of beryllia and uranyl nitrate solutions. (JRD)

3775 (PWAC-489) URANIUM CARBIDE FUEL DEVELOPMENT, SNAP-50. DeCrescente, M. A.; Freed, M. S.; Caplow, S. D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Oct 1965. Contract AT(30-1)-2789. 130p. Dep. NTIS $9.50.

Declassified 12 Sep 1973.

The development of UC in four major areas is presented: 1) powder synthesis and power metallurgical fabrication, 2) physical and mechanical property testing, 3) fuel/cladding compatibility and barrier development, and 4) irradiation evaluation. Synthesis and sintering methods for producing large quantities of high density and high purity UC are described. Results of experimental studies of the following properties are summarized: thermal conductivity, thermal expansion, vapor pressure and thermodynamics, heat capacity, hot hardness, compressive creep and electrical resistivity. Compatibility tests are described which demonstrated the need for a diffusion barrier. Lithium soak tests for up to 11,000 hours at 2200°F demonstrated the stability and practicality of vapor-deposited tungsten-lined Nb–1 Zr alloy for use with stoichiometric UC over the projected life and temperature of SNAP-50. Massive carbon diffusion was observed in the Nb–1 Zr alloy clad-

ding when tantalum was used as a barrier with hyperstoichiometric UC. Similar static tests of purposely defected simulated fuel pins indicated only minimal reactions in the case of stoichiometric UC versus tungsten compared with hyperstoichiometric UC versus tantalum or Nb–1 Zr alloy. Instrumented capsule irradiation tests of simulated Nb–1 Zr alloy and Nb–1 Zr–0.08 C (PWC-11) alloy clad fuel pins are described under 2 and 8 Mw(t) SNAP-50 conditions. Under 8 Mw(t) conditions, 20% fission gas release and 2% diametral cladding growth were observed after 2370 hours at 2200°F (1.5 at.% U burnup). Inpile operation under 2Mw(t) conditions was achieved for 3660 hours at 1950°F (0.73 at.% U burnup) and 2360 hours at 2200°F (estimated 0.8 at.% U burnup) while experiencing less than 1.0% fission gas release and insignificant diametral growth. (72 figures, 45 references) (auth)

3776 (RT/FI-(73)41) USE OF Gd_2O_3 AS A FUEL POISON FOR PWR REACTORS. Final Report of the Irradiation of Samples in the SILOE Reactor. Lepscky, C.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Nov 1973. 49p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50.

The results are reported of calculations performed to define the set-up of the experiments–conducted by Nuclear Ship Program of CNEN of the SILOE' reactor (C.E.A.-Grenoble)–which consist of irradiating natural UO_2 samples containing Gd_2O_3 in different concentrations. (auth)

3777 LOW TEMPERATURE MAGNETIC PROPERTIES OF THE $(Ti,V)_2O_3$ SYSTEM. Van Zandt, L. L. (Purdue Univ., Lafayette, IN). Mater. Res. Bull.; 9: No. 5, 593-602(May 1974).

The properties of an earlier model for the electronic structure of V-doped Ti_2O_3 are briefly summarized. The model is generalized to include the effects of application of an external magnetic field in order to make definitive predictions. Experimental confirmation would provide strong grounds for preferring this model over previous suggestions. (6 figures) (auth)

3778 CRYSTALLOGRAPHIC SHEAR PHASES IN THE SYSTEM Ti_xWO_3. Ekstroem, T. (Univ. of Stockholm); Tilley, R. J. D. Mater. Res. Bull.; 9: No. 5, 705-714(May 1974).

Samples of WO_3 doped with titanium, and having the overall formula Ti_xWO_3 ($0 < x < 0.04$) and $Ti_{0.01}W_{0.99}O_{2.80}$, were studied by x-ray diffraction and electron microscopy. All samples were inhomogeneous and contained a variety of structural types. The major components present were WO_3 and crystallographic shear (CS) phases based upon {102}, {103}, and {001} CS planes. In general the CS plane type altered from {102} through {103} to {001} as the degree of reduction increased. Intergrowths of {103} and {001} CS planes were seen, but no CS planes with indices {102} and {103} or {103} and {001} were found. (auth)

3779 REMARKS ON THE MUTUAL SOLUBILITIES AND SUPERCONDUCTIVITY OF HEXABORIDES. Fisk, Z.; Lawson, A. C.; Fitzgerald, R. W. (Univ. of California, San Diego, La Jolla). Mater. Res. Bull.; 9: No. 5, 633-636(May 1974).

X-ray diffraction and electron microprobe data indicate that the mutual solubility of LaB_6 and YB_6 depends strongly on the method of alloy preparation. Superconducting transition temperatures of these alloys are reported. (auth)

3780 ELECTRON PARAMAGNETIC RESONANCE OF $^{239}Pu^{3+}$ AND $^{243}Am^{4+}$ IN CeO_2 AND OF $^{241}Pu^{3+}$ IN ThO_2. Kolbe, W.; Edelstein, N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Finch, C.B.; Abraham, M.M. J. Chem. Phys. 60: No. 2, 607-609 (15 Jan 1974).

The g values of the $5f^5$ ions Pu^{3+} and Am^{4+} in CeO_2 cubic symmetry sites have been measured by EPR techniques and found to be 1.333 ± 0.001 and 1.3120 ± 0.0005, respectively. For the case of Pu^{3+}, the cubic crystal field parameters were calculated and compared with those previously obtained for other fluorite-structure lattices. The EPR spectrum was also observed for ^{241}Pu in ThO_2 and the ratio of the magnetic moments $^{241}\mu_1/^{239}\mu_1$ determined to be 3.52 ± 0.06. (auth)

3781 STUDY OF DEFECTS CREATED BY IMPLANTATION IN ZnTe USING CHANNELING. Bontemps, A.; Ligeon, E.; Marine, J.; Pfister, J. C. (CEN, Grenoble, France). J. Phys. (Paris), Colloq.; No. 5, 111-118(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Values are presented for the critical angles and the minimum yields at 300 and 70°K. The amount of damage occurring was studied as a function of the dose of implanted argon ions (120 keV). A sharp increase in the rate at which defects are produced occurs when the dose exceeds 3.10^{14} ions/cm^3. When higher doses are considered the random level is not attained. This property might be explained by the migration of defects at room temperature. Analyses at 77°K did not enable this hypothesis to be verified. In contrast, they demonstrated the existence of a surface sputtering phenomenon. The existence of a preliminary annealing stage at 350°C (isochronous annealing between 300 and 750°C) was established for samples implanted with boron at 50 keV. (FR)

3782 AMORPHIZATION, RECRYSTALLIZATION, AND ELECTRICAL ACTIVITY OF IMPLANTED SILICON LAYERS. Prisslinger, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Kalbitzer, S.; Grob, J. J.; Siffert, P. J. Phys. (Paris), Colloq.; No. 5, 85-91(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Charged particle backscattering techniques were used to determine the dose of $^{28}Si^+$ ions (10 to 60 keV) necessary to cause a silicon monocrystal to become amorphous: 1 to 3.10^{15} cm^{-2} at 300°K. This value is larger than that already measured using the same method, but agrees fairly well with values obtained using other methods. Other ions ($^{27}Al^+$ and $^{31}P^+$) having similar masses yielded similar values. Analysis of the recrystallization of bombarded zones after annealing up to 1100°C established the effect of the nature of the ions. At high temperatures, doses exceeding the threshold for the creation of an amorphous layer lead to a different type of recovery. (FR)

3783 REACTIONS OF MIXED OXIDES OF IRON AND CHROMIUM WITH LIQUID SODIUM. Charles, R. G. (Westinghouse Research Labs., Pittsburgh). pp 213-218 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Chemical reactions between mixed iron–chromium oxides of composition $Fe_xCr_{2-x}O_3$ and excess liquid sodium were studied as part of a program dealing with model systems pertinent to stainless steel corrosion chemistry. Thermomagnetic analysis was employed as the principal experimental method. Observed products of reaction were dependent on the system temperature and on the specific composition of the iron–chromium oxide used for study. Important reactions in successively higher temperature regions include (1) reduction to iron–chromium alloys, (2) formation of sodium chromite, and (3) double sodium-iron oxide formation. (auth)

3784 GROWTH OF URANIUM DIOXIDE SINGLE CRYSTALS BY CHEMICAL VAPOR DEPOSITION. Singh, R. N.; Coble, R. L. (Massachusetts Inst. of Tech., Cambridge). J. Cryst. Growth; 21: No. 2, 261-266(Feb 1974).

Single crystals of uranium dioxide are grown on uranium dioxide substrates with (100) and (111) orientations. The growth kinetics have been studied in a closed system using chlorine as the transporting agent. The crystals are characterized using x-ray diffraction, chemical analysis, chemical etching, micro-hardness measurements, and scanning electron microscopy. The characteristics are related to the growth conditions. (auth)

3785 NEW τ-BORIDES. Rogl, P.; Nowotny, H. (Univ. Vienna). Monatsh. Chem.; 104: No. 5, 1325-1332(Sep 1973). (In German).

The following τ-borides were synthesized: $Cr_{13}Ir_{10}B_8$, $Mn_{16}Ir_7B_8$, $Fe_{10-15.4}Ir_{13-7.6}B_8$, $Co_{15}Ir_9B_8$. (auth)

3786 APPROXIMATE CORRELATION BETWEEN HEATS OF FORMATION OF OXYGEN VACANCIES AND THERMOCHEMICAL PROPERTIES OF OXIDES. Vijh, A. K. (Hydro-Quebec, Montreal). J. Mater. Sci.; 9: No. 2, 334-335(Feb 1974).

Kofstad (J. Phys. Chem. Solids; 28:1842 (1967)) has shown that the heat of formation values for doubly charged oxygen vacancies $\Delta H_{V_O}2.$, for TiO_2, V_2O_3, Nb_2O_5, Ta_2O_5, WO_3 and Y_2O_3 are given by the rough empirical equation $\Delta H_{V_O}2. = 2(E_a - 167)$ where E_a is the heat of atomization, per oxygen atom, of the given oxide. This correlation was rationalized by suggesting that $\Delta H_{V_O}2.$ is an expression for the energy needed to remove a mole of oxygen atoms from oxygen sites in the oxide and that E_a is an expression for the total average bond strength of the oxide per gram atom of oxygen. This point of view is explored further and a possible rationalization for the number "167" in Kofstad's rough correlation is suggested. (UK)

3787 LUMINESCENCE OF UNDOPED MgO UNDER IRRADIATION WITH 500-keV PROTONS. Seiyama, T.; Yoshida, T.; Hiraoka, E. (Radiation Center of Osaka Prefecture, Sakai). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 73-75(Mar 1973).

The 361-nm zero-phonon line which was always accompanied by the 376-nm luminescence band was produced in undoped MgO by 500-keV proton irradiation. The luminescence bands of N^{2+} ions, and Cr^{3+} ions existing in octahedral and tetragonal symmetries was observed under the proton irradiation. All the luminescence bands were observed to decrease in intensity with irradiation. Two stages were found of annihilation processes of the two types of the luminescence centers; Cr^{3+} ion-anion vacancy associate ($Cr^{3+}-O^{--}-V_{Mg}$), and Cr^{3+} ion-anion vacancy pair ($Cr^{3+}-$

$O^- - V_{Mg} - O^- - Cr^{3+}$), which are governed by the first order reaction kinetics. (auth)

3788 NEW METHOD FOR THE PREPARATION OF CARBIDE FUEL PARTICLES. Naoumidis, A.; Neu, K.; Nickel, H. (Kernforschungsanlage, Juelich, Ger.). pp 249-252 of Reactor Meeting. Section 2. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). (In German).

A new method for the preparation of spherical UC_2-particles is described; the base material, sintered spherical UO_2 particles, is coated with a carbon layer, with subsequent heterogenous reduction of the particles under vacuum. (GE)

3789 FILLED UP Re_3B-TYPE IN THE SYSTEMS (Zr,Hf)-(Fe,Co,Ni)-O. Boller, H. (Univ., Vienna). Monatsh. Chem.; 104: No. 2, 545-549(Mar 1973). (In German).

It is shown that the octahedral voids of the Re_3B-type are partially filled up by oxygen in the above systems. The homogenous ranges of x of the phases Zr_3CoO_x, Zr_3NiO_x, Hf_3CoO_x, and Hf_3NiO_x are studied. (auth)

3790 EMISSION PROPERTY OF ALLOYS OF REFRACTORY METALS WITH ZIRCONIUM CARBIDE. Matskevich, T. L.; Krachino, T. V. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2538-2542(Dec 1973). (In Russian).

The work function and thermoemission properties of the heat-resistant alloys W-ZrC and Re-ZrC are studied. The dependence of the work function on the concentration of ZrC is determined. The temperature dependence is also determined. At low temperatures the work function is practically equivalent to that for ZrC; with increase of the temperature the work function increases. Some difference in the thermodynamic properties of the two alloys indicates differences in the diffusion rate and heat of evaporation of Zr in these alloys. (JSR)

3791 CRYSTAL GROWTH AND CRYSTALLOGRAPHIC STUDY OF Sr_2EuFeO_5. Drofenik, M.; Kolar, D.; Golic, L. (Univ. of Ljubljana, Yugoslavia). J. Cryst. Growth; 21: No. 2, 305-306(Feb 1974).

Sr_2EuFeO_5 has been synthesized in both powder and single crystal form. Cell dimensions and space group of the tetragonal crystals have been determined. (auth)

3792 CRYSTAL WEIGHING MECHANISM FOR GROWTH MONITORING OF CZOCHRALSKI GROWN CRYSTALS. Reinert, R. C.; Yatsko, M. A. (Bell Telephone Labs., Inc., Allentown, PA). J. Cryst. Growth; 21: No. 2, 283-286(Feb 1974).

A sensitive lever mechanism capable of accurately monitoring the weight of a growing, rotating crystal boule is described. The low noise weight data can be processed by an analog control system or an automatic, digital, adaptive control system to grow a boule to a programmed diameter. The operational success depends on the frictionless mechanical multiplication of the load and electronic expansion of the transducer response. The resulting monitoring sensitivity has produced lithium tantalate, lithium niobate and neodymium gallium garnet boules of 22 mm diameter with ±0.4 mm variation over the length of the boule. The mechanism is schematically shown incorporated in a newly designed crystal puller to illustrate its functional uniqueness and potential adaptability to crystal pulling systems of other types. (auth)

3793 DEFORMATION AND THE RUPTURE OF SOLIDS SUBJECTED TO MULTIAXIAL STRESSES. Volume I. Concretes. Volume II. Other Materials. Volume III. Testing Methods and Interpretation of the Results. Volume IV. General Reports. International Conference Held at Cannes, France, October 4, 1972. Paris; Editions Essor (1973). 838p. (In French and English).

The colloquium is divided into 4 parts: concretes; other materials; testing methods and interpretation of the results; general reports. 46 papers were presented; 7 of them have been abstracted for NSA. (FR)

For abstracts of individual papers see: 3794-3799 and 3951.

3794 DETERMINATION OF THE COLD WORKING ELASTIC LIMIT OF A WET CONCRETE SUBJECTED TO TRIAXIAL STRESSES. Avet-Flancart, R. (CEN de Saclay, Gif-sur-Yvette, France); Costes, D.; Bergues, J.; Habib, P. pp 7-22 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. I. Paris; Editions Essor (1973). (In French).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

The elastic limit of a material is defined. The way in which the criterion can be represented in a σ_1, σ_2, σ_3 stress space is described. The elastic field region experimentally determined for a wet concrete is presented. The existence of two distinct zones (brittle and ductile) was established. The behavior of the elasticity following a severe loading (beyond the elastic limit) was then studied. The results indicate that favorable effects occur with ductile material, while unfavorable effects occur with brittle material. (FR)

3795 TRIAXIAL CREEP OF CONCRETES. Bergues, J.; Habib, P. (Ecole Polytechnique, Paris). pp 23-35 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. I. Paris; Editions Essor (1973). (In French).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

New equipment for examining creep under triaxial stress is described. The preliminary results obtained for a wet concrete are presented. (FR)

3796 EXPERIMENTAL RESEARCH ON DEFORMATION AND FAILURE OF CONCRETE UNDER TRIAXIAL LOADS. Bertacchi, P.; Bellotti, R. (Ente Nazionale per l'Energia Elettrica, Milan). pp 37-52 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. I. Paris; Editions Essor (1973).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

The triaxial behavior of concrete was studied. Results are presented from test carried out on cubic samples including measurements of the deformation between faces. The tests were effected using externally induced stresses, loads of T_2 and T_3 being applied by horizontally positioned jacks and a load T_1 being applied using a press. Frictionless materials were interposed between the specimen and loading plates. A measurement device provided with inductive transducers enabled the deformation of the specimens to be monitored throughout the test until failure occurred. The results obtained for different concretes are presented. (FR)

3797 BEHAVIOR OF A CONCRETE UNDER TRIAXIAL STRESSES. Gachon, H. (Ecole Nationale Superieure d'Arts et Metiers, Paris). pp 53-70 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. I. Paris; Editions Essor (1973). (In French).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

Tests carried out on triaxially stressed cubic concrete samples are described and analyzed. The investigations cover: the deformality (Young's modulus and Poisson's ratio) up to 500 bars, the samples (having 140 mm sides) being compressed along their three orthogonal axes; failure mechanisms under multiaxial compression (samples having 70 mm sides); determination of the ultimate strength (samples having 70 mm sides) under triaxial compression and under biaxial compression with uniaxial tensions along the three orthogonal axes. These concrete samples are made of the same material as the two 1/5 models of the Bugey I Caisson built at Chinon. (FR)

3798 DEFORMATION AND FAILURE OF HARDENED CEMENT PASTE SUBJECTED TO MULTIAXIAL STRESSES. Palaniswamy, R.; Shah, S. P. (Univ. of Chicago). pp 169-179 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. I. Paris; Editions Essor (1973).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

Specimens of hardened Portland cement paste subjected to constant lateral pressure were ruptured with axial pressure. It was observed that paste specimens undergo a radical transition when the lateral pressure exceeds 4000 psi. For lateral pressures below 4000 psi, an increase in lateral pressure results in an increased deformation at rupture, and a decrease in the secant modulus of elasticity at rupture; failure occurs by splitting. For lateral pressures higher than 4000 psi, an increase in lateral pressure results in a reduced deformation at rupture and an increase in the modulus of elasticity; failure occurs by crushing. The difference between the lateral pressure and the maximum axial pressure increases and then decreases with increasing lateral pressure. This fact indicates that the paste will not resist any increase in axial stress when the lateral pressure is sufficiently high. This possibility of a finite hydrostatic strength has also been observed for two other porous materials: snythetic foam and tuff rock. (FR)

3799 SIGNIFICANT COMPLEX STRESS STATES IN PRESTRESSED CONCRETE PRESSURE VESSELS. Langan, D.; Garas, F. K. (Taylor Woodrow Construction Ltd., Southall, Eng.). pp

203-226 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. IV. Paris; Editions Essor (1973).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

Results are presented from a series of investigations into the strength of concrete under a variety of loading conditions specifically related to those occurring in a prestressed concrete pressure vessel. The behavior of limestone concrete subject to the following stress states is discussed: biaxial and triaxial compression; the combined action of high shearing forces and biaxial restraint; the combined action of thermal and mechanical loading. The effect of size, geometry, and restraint on the experimental results obtained for small concrete elements is examined and the applicability of extrapolating the results to a full scale pressure vessel is discussed. It is concluded that a single general criterion cannot be formulated to predict the collapse of concrete under all states of applied stress. (FR)

3800 EUTECTIC BONDING OF BORON–ALUMINUM STRUCTURAL COMPONENTS. Niemann, J. T.; Garrett, R. A. (McDonnell Douglas Astronautics Co., St. Louis). Weld. J. (N.Y.); 53: No. 4, 175-s-184-s(Apr 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

A study was undertaken as part of a major program to develop a low pressure technique for fabricating boron–aluminum structural components. The method selected consists of joining monolayer foils together by a brazing process which relies on the diffusion of a thin surface layer of copper into the aluminum matrix to form a liquid phase when heated above the copper–aluminum eutectic temperature. Laboratory investigations conducted to establish a suitable bonding cycle are described. First, the effect of holding time within a selected bonding temperature range on filament degradation was determined. Then, a copper coating thickness was selected to be compatible with a bonding cycle that would minimize the loss of filament strength. These studies showed that sound, strong joints could be produced by limiting the coating thickness to 20 microin and restricting the bonding temperature to the range between 1030 and 1060°F with the time not to exceed 15 min at the lower temperature limit or 7 min at the upper limit. Techniques for including titanium interleaves in boron–aluminum laminates are described and typical properties of eutectic bonded B/Al laminates are presented. (auth)

3801 METHOD FOR THE PRODUCTION OF URANIUM MONOCARBIDE. Akimoto, Y.; Tanaka, K. (to Mitsubishi Kinzoku Kogyo Kabushiki Kaisha). US Patent 3,798,303. 19 Mar 1974. Priority date 27 May 1969, Japan, 6p.

An improved method is described for the production of uranium monocarbide adapted to manufacture a nuclear fuel and having a composition of high density and a carbon content of which is approximately equivalent to the stoichiometric composition. The uranium carbide as a raw material is subjected to fusing treatment by an inert plasma flame consisting of argon and hydrogen, to implement fusing of the carbide and control of carbon content of the carbide in one step. (Official Gazette)

3802 PREPARATION OF AQUEOUS REDISPERSIBLE GELS OR STABLE DILUTABLE SOLS CONTAINING TUNGSTEN AND TITANIUM AND TITANIUM–TUNGSTEN CARBIDES THEREFROM. Fox, A. C.; Hyde, K. R. (to United Kingdom Atomic Energy Authority). US Patent 3,795,522. 5 Mar 1974. Priority date 5 Oct 1970, United Kingdom of Great Britain and Northern Ireland. 12p.

Aqueous, stable, dilutable sols and aqueous, redispersible gels having a weight ratio of TiO_2 : WO_3 of at least 0.15 containing tungsten and titanium and optionally other metals are made by mixing freshly precipitated tungstic acid or a tungstate with an aqueous solution of a titanium salt. The sols and gels may be calcined at temperatures below 1800°C in the presence of carbonaceous material to give mixed tungsten–titanium carbides. (Official Gazette)

3803 METHOD FOR PREPARING MASSIVE NITRIDES. Chang, J. Y.; Ewing, W. M.; Fulkerson, W.; McElroy, D. L.; Weaver, S. C. (to United States Atomic Energy Commission). US Patent 3,804,928. 16 Apr 1974. Filed date 25 Jan 1972. 4p.

Actinide nitride and other metal nitride structures of relatively large mass are prepared by confining a metal body in a nitrogen atmosphere and then subjecting the body to a moving-zone melting operation. The metal nitride resulting from the reaction between the molten metal and the nitrogen is of essentially stoichiometric composition and of essentially theoretical density. The examples cover uranium and thorium nitride. (Official Gazette)

3804 HOT PRESSING PROCESS. Hagie, L. T.; Ryer, C. M. (to General Electric Co.). Canadian Patent 914,901. 21 Nov 1972.

Hot-pressing ceramic nuclear fuel has advantages over cold-pressing and sintering; for example, no subsequent grinding to size is necessary, and pellets with dished ends can be obtained directly. According to the invention, actinide oxide powder is loaded into a die and pressed to 6000 to 10,000 psig; the temperature is then raised to 900 to 1300°C, and pressing is continued for 3 to 20 minutes. The oxide is preferably hyperstoichiometric uranium dioxide or a mixture of uranium and plutonium dioxides, of average particle size less than 0.1 μm. It is advantageous to preform crumbly pellets at about 1000 psig before hot-pressing. (CA)

3805 TRANSPARENT THORIA-BASE CERAMICS AND METHOD FOR PRODUCING SAME. Anderson, R. C. (to General Electric Co.). Canadian Patent 916,422. 12 Dec 1972.

Transparent thoria ceramics useful for windows in high-temperature equipment are made by pressing and sintering a mixture of thorium dioxide with 0.5 to 5.0 molar % yttrium oxide. The initial powders should have a particle size in the range 0.01 to 2.0 μm. The powder should be pressed at 5,000 psi at least, and sintered at 2000°C or higher under an atmosphere of hydrogen and water vapor having a dew point ranging from −25 to +25°C. (CA)

3806 ENTHALPY OF FORMATION OF PLUTONIUM SESQUICARBIDE. Johnson, G. K.; Van Deventer, E. H.; Hubbard, W. N. (Argonne National Lab., IL). J. Chem. Thermodyn.; 6: No. 3, 219-225(Mar 1974).

The energy of combustion in oxygen of a sample of plutonium sesquicarbide having a composition $PuC_{1.467\pm0.009}$ was measured in a bomb calorimeter. The standard enthalpy of formation, ΔH_f° ($PuC_{1.467\pm0.009}$, c, 298.15°K), was determined to be $-(19.80 \pm 0.97)$ $kcal_{th}\ mol^{-1}$. (auth)

3807 CRYSTAL STRUCTURE OF THE BINARY OXIDE γ–$U_3Mo_{20}O_{64}$. Serezhkin, V. N.; Kovba, L. M.; Trunov, V. K. (Moscow State Univ.). J. Struct. Chem. (USSR) (Engl. Transl.); 14: No. 4, 689-691(1973).

Translated from Zh. Strukt. Khim.; 14: No. 4, 742-744(1973).

X-ray diffraction studies were made of the binary oxide γ–$U_3Mo_{20}O_{64}$. The atomic coordinates and the principal interatomic distances were determined. A comparison of the crystal-chemical formulas of the α and γ–$U_3Mo_{20}O_{64}$ shows the relation of these two compounds and that the factor responsible for their structural difference is related to the arrangement of the U and Mo atoms and vacancies over the positions occupied by the U atoms in the β compound. (JSR)

3808 PROCESS FOR CHEMICAL VAPOR DEPOSITION OF ZIRCONIUM CARBIDE. Ikawa, K.; Kobayashi, F.; Iwamoto, K. (to Japan Atomic Energy Research Inst.). US Patent 3,804,664. 16 Apr 1974. Priority Date 24 Sep 1970, Japan. 4p.

Deposition of zirconium carbide on a substrate is advantageously effected by reacting zirconium and methyl iodide under heating. The deposition of zirconium carbide is useful for coating of a rocket nozzle surface, coating of granular fuels for gas cooled nuclear reactor, and the like. (Official Gazette)

3809 DENSIFICATION OF PROMETHIUM SESQUIOXIDE. Fullam, H. T.; Jarrett, J. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 305-336 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

High-purity Pm_2O_3 is normally produced as a finely divided powder. Most applications call for the densification of the oxide powder into compact shapes. This chapter describes various methods which have been studied as a means of compacting Pm_2O_3 powder into high-density bodies. The advantages and disadvantages of the various methods are discussed. Most of the compaction methods discussed were evaluated at PNL and are described in detail. Open-literature references to compaction studies at other laboratories are limited and description of the work is, by necessity, limited to generalities. (auth)

3810 PRECIPITATION STUDIES IN THE SYSTEM WC–ZrC. Brun, M.; Stubican, V. S. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc.; 57: No. 3, 117-119(Mar 1974).

The solubility of WC in ZrC varied from 25 mol % at 1800°C to 65 mol % at 2550°C. There was no detectable solubility of ZrC in WC in the same temperature range. Tungsten carbide precipitates from supersaturated WC–ZrC solutions as rods. The crystallographical relation between the precipitated phase and the matrix established by electron diffraction techniques is: $[100]_{WC} \parallel [1\bar{1}0]_{ZrC}$ and $[010]_{WC} \parallel [01\bar{1}]_{ZrC}$. The interfacial planes were (011) for WC and (111) for ZrC. The hardness of the solid solution of 55 mol % WC and 45 mol % ZrC increased ≈10% after it was annealed at 1900°C. (auth)

3811 THERMAL DIFFUSIVITY OF Be_4B, Be_2B, AND BeB_6. Holt, J. B. (Univ. of California, Livermore). J. Amer. Ceram. Soc.; 57: No. 3, 126-129(Mar 1974).

The thermal diffusivities of polycrystalline Be_4B, Be_2B, and BeB_6 were measured by the flash method. Generally, the thermal diffusivities at a given temperature decrease with increasing boron content. The thermal diffusivities of Be_4B, Be_2B, and BeB_6 varied from 0.13 to 0.072 to 0.031 cm^2/s, respectively, at 200°C and from 0.068 to 0.038 to 0.007 cm^2/s at 1000°C. Heat transport in BeB_6 is expected to occur almost entirely by phonon conduction, whereas electronic conduction probably plays a major role in Be_4B and Be_2B. Analytical expressions for the thermal diffusivities (α) of Be_4B and Be_2B at 200 to 1000°C and of BeB_6 at 25 to 1500°C are: $\alpha(Be_4B) = 1/(5.83 + 9.05 \times 10^{-3}\ T)$, $\alpha(Be_2B) = 1/(10.92 + 1.40 \times 10^{-2}\ T)$, and $\alpha(BeB_6) = 5.60 \times 10^{-4} + 5.72/T + 77.3/T^2 - 4.09 \times 10^4/T^3$ cm^2/s. (auth)

3812 VISCOUS FLOW IN GLASS DURING PHASE SEPARATION. Simmons, J. H.; Mills, S. A.; Napolitano, A. (National Bureau of Standards, Washington, DC). J. Amer. Ceram. Soc.; 57: No. 3, 109-117(Mar 1974).

The isothermal viscosities of two borosilicate glasses, one a commercial glass widely used for chemical glassware, increase by 4 to 5 order of magnitude with heat-treatment time near the annealing point. The glasses are basically sodium borosilicates but differ greatly in phase-separation characteristics. Electron micrographs were used to analyze the development of microstructure during the suspected phase separation. In both glasses, structure development is primarily responsible for the viscosity increase. An analysis of the data and a theoretical interpretation of the effect are presented. (9 fig) (auth)

3813 MICROSTRUCTURAL DEVELOPMENT IN PARTIALLY STABILIZED ZrO_2 IN THE SYSTEM CaO–ZrO_2. Green, D. J.; Maki, D. R.; Nicholson, P. S. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 57: No. 3, 136-139(Mar 1974).

The microstructures of three zirconias partially stabilized with CaO were investigated using scanning electron microscopy and qualitative and quantitative x-ray analysis. The structure was closely related to the heat treatments involved in fabrication. A bimodal structure with small grains of pure ZrO_2 dispersed along the grain boundaries of larger cubic solid-solution grains developed during slow cooling from 1850 to 1300°C. The presence of a liquid phase greatly enhances the growth of the pure ZrO_2 phase. An anneal at 1300°C induces precipitation of fine ZrO_2 particles within the solid-solution grains. The relative mechanical strengths of the materials are explained in terms of the weakening of the grain boundaries associated with the transformation of the grain-boundary phase on cooling. (auth)

3814 METAL CARBIDE SPHERULES ENCAPSULATED WITHIN A PYROLYTIC CARBON SHELL. Schulz, D. A.; Turner, C. L. T. (to United States Atomic Energy Commission). U. S. Patent 3,799,790. 26 Mar 1974. Filed date 10 Sep 1970. 8p.

A process is described for producing nuclear fuel particles having a fissionable metal carbide spherule encapsulated within a protective pyrolytic carbon shell having an inner diameter greater than the outer diameter of the enclosed spherule. A layer of aluminum oxide is deposited on a fissionable metal carbide spherule, pyrolyzing a hydrocarbon gas and depositing the pyrolytic carbon thereby produced to form a substantially uniform porous coating on the aluminum oxide layer. The coated particle is then heated to volatilize and diffuse the aluminum oxide layer through the porous carbon coating, leaving a void between such coating and the metal carbide spherule. After the aluminum oxide layer has been diffused through the porous pyrolytic carbon coating, a denser high-strength protective coating of pyrolytic carbon can be applied to the spheroid. (Official Gazette)

3815 DIRECT OBSERVATION OF CRYSTALLOGRAPHIC SHEAR PLANE GROWTH IN SOME TUNGSTEN OXIDES. Sundberg, M.; Tilley, R. J. D. (Univ. of Bradford, Yorkshire, Eng.). Phys. Status Solidi (a); 22: No. 2, 677-684(16 Apr 1974).

Crystals of tungsten oxides belonging to the homologous series W_nO_{3n-2} and which contain {103} crystallographic shear (CS) planes were observed by high-resolution electron microscopy. Under the influence of the electron beam, CS planes were observed to grow in the matrix of the parent oxide lying between existing CS planes. This growth mainly follows a dislocation mechanism but other rearrangements of the CS planes were also observed, which entail the use of different mechanisms to account for the structural changes taking place. (auth)

3816 NON-LINEARITY OF THE VOLT-AMPERE CHARACTERISTICS AT THE BOUNDARY OF A LIQUID SEMICONDUCTOR WITH METALS. Zolyan, T. S. (Inst. of Radiophysics and Electronics, Erevan). Dokl. Akad. Nauk Arm. SSR; 55: No. 3, 171-173(1972). (In Russian).

The volt–ampere characteristics of liquid V_2O_5 in contact with Pt, W, or Ta were measured. The dependence of the sign of the thermo emf of the oxide was determined as a function of temperature. The non-linear unipolar character of the conductivity of the metal–liquid V_2O_5 contact was shown. (JSR)

3817 STUDIES ON IRRADIATION-RESISTING PAINTS FOR CONCRETE BUILDING IN NUCLEAR POWER PLANTS. I. Kita, D.; Sumino, M. (Obayashi-Gumi, Ltd., Tokyo). Obayashi-Gumi Gijutsu Kenkyusho-Ho; No. 6, 177-181(Aug 1972). (In Japanese).

Radiation resistant coating materials are employed in the concrete parts of buildings containing reactors, turbines, and auxiliaries. Contamination must be easily washed and removed from the coating materials, and the materials should not be deteriorated by radiation or hot water. At present, six kinds of the coating materials of epoxy and phenolic resins are commercially available as the radiation resistant materials. They were compared by testing impact strength, abrasion resistance and adhesive property before and after the irradiation with ^{60}Co at 1×10^8R, 1×10^9R and 1×10^8R, which are equivalent to 1, 10, and 100 hours of the irradiation at 1×10^8R respectively. Autoclave test was also carried out before the irradiation with 4,000 ppM boric acid and 0.7% NaOH solution, wherein samples were immersed, and temperature was raised to 160°C in 1 h, thereafter lowered to 140°C in 2 h, still lowered to 100°C in 21 h, and then lowered to 66°C in 72 h. The samples were 150 × 260 × 100 mm rectangular concrete blocks, 105 × 105 × 4 mm commercial slate plates and 100 × 100 × 12 mm mortal plates, and they were left untouched for 20 days after coating was finished. As the results of the tests, no deterioration occurred at 1×10^8R, all samples browned at 1×10^9R, and swelling, exfoliation and cracking of films appeared at 1×10^9R probably due to cross linking. (JA)

3818 COLOR CENTERS IN YTTRIUM ALUMINATE CRYSTALS ACTIVATED WITH TRANSITION METAL IONS. Antonov, V. A. (Moscow Energetic Inst.); Arsenev, P. A.; Vakhidov, Sh. A.; Ibragimova, E. M. Phys. Status Solidi (a); 22: No. 2, 391-399 (16 Apr 1974).

Absorption and luminescence spectra and thermal glow curves of γ-irradiated $YAlO_3$ monocrystals doped with transition iron group ions are investigated. The valence states of activator ions are determined and absorption and luminescence transitions are identified. The magnitudes of the Racah parameters, B and C, and the internal crystal field strength, D_q, are calculated by means of energy matrices, which lead to the best agreement between the experimental and theoretical values of the transfer energies. The influence of ionizing radiation and high-temperature treatments of crystals on the optic characteristics of host-lattice and activator ions is shown. (8 fig) (auth)

3819 THERMAL EXPANSION OF BeO · Al_2O_3, BeO · $3Al_2O_3$, AND 3BeO · $8Al_2O_3$ · 5MgO. Woolfrey, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Aust. Ceram. Soc.; 9: No. 1, 33(May 1973).

The ternary oxide system BeO–Al_2O_3–MgO was studied during an investigation of the coating surfaces with Al_2O_3 containing MgO as sintering aid. Thermal expansion data were obtained for the major compounds identified in the ternary system, namely BeO · $3Al_2O_3$, BeO · $3Al_2O_3$ and 3BeO · $8Al_2O_3$ · 5MgO. (AT)

3820 STABILITY OF THE MONOCLINIC MODIFICATION OF AMERICIUM AND EUROPIUM SESQUIOXIDES. Berndt, U.; Tanamas, R.; Maier, D.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett.; 10: No. 4, 315-321(Apr 1974). (In German).

X-ray studies of high-purity $AmO_{1.5}$ show that monoclinic $AmO_{1.5}$ does not exist in pure form but can be stabilized by incorporating small quantities of extraneous oxide (e.g. ≤ 2 mol % $REO_{1.5}$). It had already been found [Fitzgibbon et al., Thermodynamics; 4: 349 (1972)] by determining the enthalpy of formation of $EuO_{1.5}$ that cubic $EuO_{1.5}$ is the thermodynamically stable modification at room temperature, and it was found using a solid-state voltaic cell that this is also the case in the range $800 \leq T \leq 1050$°C. This means that T = 1050 ± 20°C is the true transition point for the transition cubic $EuO_{1.5}$ ⇌ monoclinic $EuO_{1.5}$. It follows that monoclinic $EuO_{1.5}$ is not a true low-temperature modification but is formed topochemically and then exists as a metastable phase only up to the transition point of 1050°C. (UK)

3821 STABILIZED ZIRCONIA AND A PROCESS FOR THE PREPARATION THEREOF. Pitts, F. (to Magnesium Elektron Ltd.). British Patent 1,342,406. 3 Jan 1974. Filed date 29 Jun 1971. 5p.

Because of its very high melting point (2650°C) and its chemical inertness at high temperatures pure ZrO_2 would appear very attractive as a high temperature ceramic, but dense bodies of this material undergo a destructive volume change accompanied by a change in structure from monoclinic to tetragonal at about 1100°C.

This volume change may be reduced by addition of certain other oxides before firing the mixture to convert the ZrO_2 to a cubic modification that is stable up to the melting point. It is found that a cubic stabilized ZrO_2 containing 6 mole % Y_2O_3 can be formed from a mixture of the oxides at 2000°C, and that additions of 4 to 6 mole % Y_2O_3 can produce a tetragonal stabilized ZrO_2 that does not undergo any phase transformation at temperatures up to about 2000°C. It has also been found that ceramics based on Y_2O_3 stabilized ZrO_2 possess some additional useful features, including lower sintering temperatures, resistance to destabilization on thermal cycling, superior corrosion resistance, and improved electrical conductivity. Pure Y_2O_3 is however, an expensive material, but it has been found that ZrO_2 can be stabilized with a concentrate containing Y_2O_3 and rare earth metal oxides, thus obviating the need to prepare pure Y_2O_3. The process described consists in reacting ZrO_2 with Y_2O_3 concentrate containing 35 to 70% by weight Y_2O_3 with the remainder consisting of rare earth metals oxides, this concentrate being prepared from naturally occurring mineral material. The concentrate should be present in quantity sufficient to provide 3 to 8 mole % of yttria and rare metal oxides in the ZrO_2. The mixture is calcined for some hours at 900 to 1500°C. The Y_2O_3 concentrate before calcining is dissolved in HCl and the solution added to an aqueous slurry of Zr basic sulfate. The pH of the resulting slurry is then adjusted to 9 to cause co-precipitation of the Zr, Y, and rare earth metals as hydroxides, the precipitate then being washed to remove sulfate and chloride, followed by drying and calcining. The ZrO_2 may then be ground in the presence of water, pressed into the desired shape, and sintered. (UK)

3822 F-CENTERS IN Al_2O_3. Galindo, H.; Ruiz Mejia, C. (Univ. Nacional Autonoma, Mexico City). Phys. Status Solidi (a); 22: No. 2, K165-K169(16 Apr 1974).

The wave function and the energy level of the ground state for the F center in irradiated Al_2O_3 were calculated using Simpon's method and a crystal field formula. The following values were obtained: $E_{1s} = -6.3$ eV, $E_{2p} = -0.14$ or -0.81 eV, $\lambda_{1s} = 1.03$ au, and $\lambda_{2p} = 0.08$ au. The $E_{2p} - E_{1s}$ difference is 5.45 eV, which corresponds with one of the observations. (DLC)

Metals and Alloys

Refer also to abstracts 3024, 4415, and 5490.

3823 (CONF-710342-) FIFTH ANNUAL INFORMATION MEETING ON HEAVY SECTION STEEL TECHNOLOGY PROGRAM, OAK RIDGE, TENNESSEE, MARCH 25–26, 1971. (Oak Ridge National Lab., Tenn. (USA)). 1971. 578p. Dep. NTIS $31.00.

A total of thirty-one papers were presented at the information meeting. A separate abstract was prepared for each of twenty-nine papers. The papers for which no abstracts were prepared are concerned with industrial nondestructive testing and in-service inspection of pressure vessels. (JRD)

For abstracts of individual papers see: 3826, 3861–3863, 3896–3915, and 3998–4002.

Corrosion and Erosion

Refer also to abstracts 2634, 2636, 2978, 2979, and 5229.

3824 (AD-769340) HOT CORROSION OF METALS, ALLOYS, AND CERAMICS. Final Report, June 1971–June 1973. Uhlig, G. F. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Sep 1973. 11p. (ARL-73-147). NTIS $2.75.

A knowledge of the mechanism of accelerated oxidation due to the presence of sodium sulfate, called hot corrosion, on metals is fundamental to the design and improvement of jet aircraft gas turbines. The reaction/vaporization behavior of sodium sulfate on hot pressed oxides and on platinum was studied using continuous weight change versus time measurements. In addition, the hot corrosion behavior of TD Nickel–Chromium was also studied using continuous weight change versus time measurements. The major accomplishments of the research effort are summarized and the publications generated under this program are listed. (GRA)

3825 (AECL-4586) EFFECT OF MICROSTRUCTURE AND LATTICE STRAIN ON THE CORROSION RESISTANCE AND MECHANICAL PROPERTIES OF β-QUENCHED Zr–1.14 WT% Cr–0.1 WT% Fe. Holt, R. A.; Elder, F. G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1974. 14p. Dep. NTIS (US Sales Only) $4.00. AECL $0.50.

β-quenched Zr–1.14 wt % Cr–0.1 wt % Fe may have martensitic or Widmanstätten transformation morphologies or mixtures of the two depending on the cooling rate. In both structures, a grain boundary α phase is observed at most prior β grain boundaries. When a high hydrogen concentration is present, hydrides are observed at the prior β grain boundaries in association with the grain boundary α phase. This results in an almost continuous network of hydride through the materials. Specimens with wholly or partially martensitic structures corroded rapidly in water at 588°K. This is ascribed to high phase-transformation microstrains associated with the presence of the martensitic structure. The high hydrogen concentration associated with the high corrosion weight gains caused severe embrittlement of these specimens in room temperature tests with fracture along the prior β grain boundaries. Specimens with Widmanstätten transformation structures had much lower weight gains and hydrogen concentrations and were not embrittled. (6 figures, 5 tables) (auth)

3826 (CONF-710342-, pp vp Paper 2) FATIGUE OF ASTM A302 GRADE B STEEL IN HIGH TEMPERATURE SIMULATED NUCLEAR REACTOR ENVIRONMENT. Kondo, T.; Kikuyama, T.; Nakajima, H.; Shindo, M.; Nagasaki, R. (Japan Atomic Energy Research Inst., Tokai). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The effect of high temperature aqueous environment on the rate of fatigue crack growth was studied. The apparatus designed and constructed for this purpose consists of two electrohydraulic fatigue machines combined with a water circulating system. The specimens were prepared to contain sharp fatigue-cracked notches in simulating the wall of a steel vessel with cracks penetrated through its stainless steel weld overlay. The fatigue character of the material in water up to 280°C was compared with that in ambient air. The experimental parameters tested were: testing temperature, strain range, loading frequency, and water quality. Measurements were made on both the number of cycles to failure and the rate of crack growth under fixed displacement amplitudes. In the aqueous environment the fatigue life of the specimens was generally reduced relative to that in ambient air under most testing conditions. Such reduction was more pronounced as the loading frequency is lowered down to around 1 cycle/m below which, however, the growth tended to frequently pause. Consequently the life was rather prolonged in a somewhat random fashion in the low frequency range. The crack growth rate was activated exponentially with increasing temperature up to around 200°C, but above which the trend was sharply reversed to cause comparatively moderate environmental effect at the normal reactor operating temperatures. The growth rate in water was more steeply dependent on the strain amplitude than in air. The observed results are discussed in terms of localized corrosion attack and stress intensity factor. (auth)

3827 (CONF-740402-8) INFLUENCE OF NONMETALLIC ELEMENTS ON THE COMPATIBILITY OF LITHIUM WITH FUSION REACTOR MATERIALS. Smith, D. L.; Natesan, K. (Argonne National Lab., Ill. (USA)). 1973. 25p. Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The thermodynamic aspects of nonmetallic element, i.e., oxygen, nitrogen, and carbon, interactions were analyzed for certain refractory metal-lithium systems of interest for controlled thermonuclear reactor applications. The results provide a basis for further experimental work that is required to establish the operating limitations of potential containment materials for lithium under controlled thermonuclear reactor conditions. The refractory metals niobium, vanadium, and molybdenum are considered as base metals for containment of lithium, and titanium, zirconium, and chromium are of interest as potential alloying elements. The nonmetallic element interactions between the refractory metals and lithium are analyzed in terms of the equilibrium distribution coefficients and the nonmetallic element concentrations in lithium sufficient for compound, i.e., oxide, nitride, or carbide, formation to occur. The types of interactions, viz., embrittlement, compound formation, reduction in strength, or lithium penetration of the refractory metals, that will probably have the greatest effect on the corrosion rates and mechanical properties of niobium, vanadium, and molybdenum in a lithium environment are discussed. Additional compatibility effects produced by alloying these refractory metals with either zirconium, titanium, or chromium are discussed. The importance of a capability to monitor and control carbon and nitrogen at low concentrations in lithium is emphasized, as is the need to establish the levels at which these impurities can be maintained in a large lithium system. (auth)

3828 (INIS-mf-932) CORROSION OF Zr ALLOYS. Tolksdorf, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 9p. (In Danish). INIS.

From Danish society for metals, winter meeting; Middlefart, Denmark(8 Jan 1973).

The corrosion of Zr-alloys in pressurized water reactors with hydrogen additions to the water is the same as without irradiation. The hydrogen uptake is at approximately 50% of the theoretical value. The oxygen concentration in boiling-water reactors greatly influences the corrosion of zirconium alloys. The corrosion rate under irradiation is much greater than that in out-of-pile experiments. The models presented explain this as being due to (1) the presence of free radicals as a result of γ-radiation, (2) increased ion conduction in the oxide layer owing to radiation damage, and (3) a modification of the n-type oxide into a p-type. Oxygen diffusion in the p-type oxide is sensitive to the oxygen pressure in water. Corrosion in steam may be explained by the embrittlement of the oxide layer due to neutron irradiation. All models are preliminary, and none of them can take into consideration all the experimental observations. (INIS)

3829 (JAERI-M-5393) THERMODYNAMICAL CONSIDERATION FOR CORROSION OF METALS IN MOLTEN FLUORIDES. The Behavior of Hastelloy-N in Molten Li_2BeF_4. Ohmichi, T.; Furukawa, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 17p. (In Japanese). NTIS (US Sales Only).

The equilibrium phase diagrams, referring to the redox potential (E) and the activity of oxygen ion (O_{2-}) in a melt consisting of Hastelloy-N alloy in Li_2BeF_4 melt, were obtained, using thermodynamic data in the literature. Based on the phase diagrams, various aspects of the corrosion of a Hastelloy-N in the melt are studied. Corrosion behavior of the alloy is dominated by that of Cr, one of the constituents of the alloy, which is most susceptible to corrosion by the fluoride melt. Since the metallic fluorides and oxides are highly soluble in the melt, a passivation on the metal surface does not occur in ordinary experimental conditions. It is necessary to reduce the partial pressure of HF and O_2 in the equilibrium gas phase to prevent corrosion of the alloy. (auth)

3830 (JAERI-M-5423) DIAGRAM FOR ZIRCALOY-2 CORROSION IN REACTOR FUEL DESIGN. Fujita, M.; Izumi, F.; Harayama, Y.; Morishima, A. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 10p. (In Japanese). NTIS (US Sales Only).

The diagrams prepared for reactor fuel design and safety evaluation, are presented, that give the weight gain and the transition period for Zircaloy-2 corrosion in water and steam under a temperature condition. (auth)

3831 SURFACE SELF-DIFFUSION OF ATOMS AND ATOM PAIRS. Graham, W.R.; Ehrlich, G. (Coordinated Science Laboratory and Department of Metallurgy, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. Lett. 31: No. 23, 1407-1408 (3 Dec 1973).

Quantitative observations have for the first time been made of the surface diffusion of single self-adsorbed tungsten atoms and atom pairs. Measurements on the (211) plane indicate that motion of single atoms is normal, occuring over a barrier of 74 kJ/mole, with a pre-exponential factor $D_0 = 10^{-3}$ cm^2/sec. Motion of pairs formed by atoms in adjacent [111] channels is highly correlated; it involves a much smaller barrier, 28 kJ/mole, and a pre-exponential factor of only 10^{-12} cm^2/sec. (auth)

3832 SOLID-GAS INTERACTIONS. Oxidation of Zr, Ti, and Ti-Zr Alloys Under Reduced Oxygen Pressure. Dechamps, M. Metaux (Corros.-Ind.); 48: No. 570, 54-58(Feb 1973). (In French).

The kinetic, morphological, and analytical characteristics of zirconium oxidation are presented. They are used to deduce the existence of an initial transient state corresponding to linear oxidation kinetics during which thermodynamic equilibrium does not occur at the metal-oxide interface. (FR)

3833 SOLID-GAS INTERACTIONS. Oxidation of Zr, Ti, and Ti-Zr Alloys Under Reduced Oxygen Pressure. Dechamps, M. Metaux (Corros.-Ind.); 48: No. 571, 117-131(Mar 1973). (In French).

The oxidation of Ti-Zr equiatomic alloy under reduced oxygen pressure was studied. Oxidation kinetics and identification of the oxidation products were elucidated. (FR)

3834 SOLID-GAS INTERACTIONS. Oxidation of Zr, Ti, and Ti-Zr Alloys Under Reduced Oxygen Pressure. Dechamps, M. Metaux (Corros.-Ind.); 48: No. 572, 151-164(Apr 1973). (In French).

Homogeneous $Ti_1Zr_1O_x$ ternary alloys, and in particular metallic solid solutions (with oxygen contents of less than 30 at. %) were studied. Ti_2ZrO was examined using crystallographic techniques. In this way, the existence of a new structure unique to this composition was established. The oxidation kinetics at low pressures were determined for titanium, zirconium, and Ti_1Zr_1. (FR)

3835 EXPLOSIVE INTERACTION BETWEEN SODIUM AND WATER, AND MATERIAL WASTAGE IN THE VICINITY OF LEAKS IN SODIUM-WATER HEAT EXCHANGERS. Newman, R. N.; Pugh, R. R.; Smith, C. A. (Central Electricity Generating Board, Berkeley, Eng.). pp 85-91 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Studies are described on two main aspects of sodium-water reactions. It was demonstrated experimentally that sodium and water may explode when mixed under certain conditions. Also, a laboratory scale sodium-water combustion system was used to provide data on the wastage of materials that may occur during a water leak into sodium in the heat exchanger of a sodium cooled fast reactor. (UK)

3836 EXPERIMENTAL STUDIES ON SODIUM/WATER REACTIONS IN STEAM GENERATORS. Bray, J. A. (Dounreay Experimental Reactor Establishment, Eng.). pp 107-113 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Sodium heated steam generators are used in all the current designs of fast breeder power stations. This has necessitated the study of the effects of sodium/water reactions in heat exchangers. The two main areas of interest are: (i) large leaks (e.g., the severance of a boiler tube) in which the problems are those concerned with relieving the generated pressure and the safe disposal of the reaction products; and (ii) small leaks where the effect of "pin hole" type leaks may be to cause rapid wastage of adjacent tubes. A program of work on these topics has been under way for several years at the Dounreay Experimental Reactor Establishment of the UKAEA. This program is discussed and the experiments used to investigate the problems are described. (auth)

3837 MATHEMATICAL MODELLING TECHNIQUES FOR LARGE SCALE SODIUM/WATER REACTIONS IN HEAT EXCHANGERS. Tregonning, K. (Dounreay Experimental Reactor Establishment, Eng.). pp 115-122 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Mathematical models which predict the venting characteristics of sodium heated steam-generators in the event of a large scale sodium-water reaction are discussed. A model is evaluated which is based on an energy balance and a rate of reaction determined by the convective mass transfer of steam/water and hydrogen. The sensitivity of the model to some of the more important parameters is studied, and the model predictions are compared with experimental data. The analysis is found to have much to recommend it when compared with the assumptions on which presently used design codes for heat exchangers are based. (auth)

3838 BEHAVIOUR OF CARBON IN SODIUM/STEEL SYSTEMS. Ainsley, R.; Hartlib, L. P.; Long, G.; Pilbeam, A.; Thompson, R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 143-148 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The processes controlling the rate and extent of carbon transport between steels in flowing sodium are discussed and experiments aimed at clarifying some of the more uncertain features are described. (auth)

3839 BEHAVIOUR OF DILUTE SOLUTIONS OF CESIUM AND BARIUM IN LIQUID SODIUM. Evans, H. E.; Watson, W. R. (Central Electricity Generating Board, Berkeley, Eng.). pp 153-158 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From International conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

A study of the behavior of barium and cesium isotopes in sodium was made. The problems inherent in using ^{137}Cs as a tracer element for cesium in sodium have been identified, and it has been shown that cesium adsorption on stainless steel is strongly dependent on surface conditions. The segregation of cesium from sodium on freezing was observed. (auth)

3840 SOLUBILITY AND DEPOSITION BEHAVIOUR OF SODIUM BROMIDE AND SODIUM IODIDE IN SODIUM-STAINLESS STEEL SYSTEMS. Allan, C. G. (Dounreay Experimental Reactor Establishment, Eng.). pp 159-164 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The solubility of NaBr and NaI was measured in liquid sodium containing 10 to 20 ppM (weight) oxygen at 150 to 400°C. The halides dissolve as the dissociated ions, solvated by the liquid sodium. Sodium halides will concentrate in reactor cold traps by crystallization and filtration, and a significant fraction of the ^{131}I decay activity from sodium-filled primary circuit components is due to halide adsorption on steel surfaces below 500°C. (auth)

3841 LIQUID METAL EMBRITTLEMENT OF STEELS BY ALKALI METALS AND ALLOYS. Cordwell, J. E. (Central Electricity Generating Board, Berkeley, Eng.). pp 177-181 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is possible that liquid metal embrittlement may arise in fast reactor steels from dissolved impurities in the liquid sodium coolant. Tensile equipment which has been set up to investigate this possibility is described. In order to test the apparatus and to provide background data, the first series of experiments was performed using pure liquid lithium, with a known embrittling effect. This metal may incidentally be present at very low levels in fast reactor sodium, although it is not known if it can have any effect at these levels. Measurements were made of the tensile properties of mild steel, 2¼ Cr–Mo steel, and 9 Cr–Mo steel at 250°C. In all cases a reduction in ductility was observed for specimens tested in pure lithium, compared with results of test in air or argon. In the case of mild steel the tensile strength was reduced. Now that the technique has been established, a second series of tests will be carried out with lithium present as a controlled low-level addition in liquid sodium. The effect of other impurities in reactor sodium also requires investigation. (auth)

3842 APPLICATION OF PHYSICAL EXAMINATION TECHNIQUES IN THE STUDY OF CORROSION AND DEPOSITION IN LIQUID METALS. Hooper, A. J. (Central Electricity Generating Board, Berkeley, Eng.). pp 201-207 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is stated that although a considerable volume of data is available demonstrating that corrosion of constructional alloys in liquid metal fast breeder reactors is influenced by temperature, Na purity, flow rate, and the presence of minor alloying elements, and that deposition of a wide range of materials can occur in Na systems, there is no publication which adequately explains the mechanisms involved in these processes, and in particular the way in which dissolved O_2 affects the rate of corrosion of Fe-based alloys. Experimental work is here described in which materials were exposed to Na under a variety of conditions, using a number of recently developed techniques. These techniques enable determination of the elemental composition and chemical bonding of compounds on metal surfaces by x-ray photoelectron and Auger spectroscopy, determination of the composition of microstructural features by energy dispersive analysis of x-rays, and investigation of the chemical bonding of Fe in deposits and foils by Moessbauer spectroscopy. A description is given of the techniques and their application. The techniques have already provided invaluable information on corrosion and deposition processes. In addition, the information provided about the nature and composition of surfaces and microstructural features should be of great use in studies of frictional and mechanical properties. (UK)

3843 CORROSION PRODUCTS IN LIQUID ALKALI METALS. Barker, M. G. (Univ. of Nottingham, Eng.). pp 219-222 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The corrosion of vanadium, niobium, and tantalum in the liquid metals, lithium, sodium, and potassium is discussed in terms of the type of corrosion products formed. Ternary oxide corrosion products are formed in liquid sodium and potassium but no interaction was observed between lithium oxide and the metals under study in the presence of liquid lithium. Corrosion in liquid lithium is therefore predicted to take place by the formation of nitrides or carbides rather than oxides. (auth)

3844 SOME ASPECTS OF CORROSION OF AUSTENITIC STEELS IN FLOWING SODIUM. Baque, P.; Champeix, L.; Lafon, A.; Sermet, E. (Sodium Reactor Tech. Dept., Cadarache, France). pp 223-231 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Stainless steel corrosion by flowing sodium has been mainly approached by the study of the steel composition influence. Different types of examinations have been made on five different steel samples exposed at 700°C. Results of weight losses, x-ray diffraction analysis, optic and electronic micrographies, and electron microprobe analysis are given. Results show that the five steels can be sorted into several families, depending on their composition. A partial explanation is given. (auth)

3845 KINETIC ASPECTS OF THE CORROSION OF AUSTENITIC STAINLESS STEEL IN HIGH TEMPERATURE SODIUM. Schwarz, N. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna); Rajakovics, G. pp 233-238 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The difference between short- and long-term corrosion effects of austenitic stainless steel exposed to high temperature sodium is described. Weight change data and surface effects are correlated to show the importance of selective weight losses on the interpretation of experimental results. (auth)

3846 SODIUM CORROSION EFFECTS ON STRUCTURAL MATERIALS OF A CORROSION LOOP AFTER 25,000 HOURS OF OPERATION. Borgstedt, H. U.; Frees, G.; Schneider, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 239-243 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is stated that very limited data have been published on the corrosion of structural materials due to long term exposure to liquid Na. There are indications of migration of interstitials and deposition of particles; decarburization is observed at 700°C. There is practically no experience with stabilized austenitic steels in liquid Na service. Knowledge of the behavior of welds in Na systems is also poor. In view of this, studies were made on parts of the corrosion loop "lerberus" to obtain information on the long-term Na corrosion of the loop materials. It was concluded that Na corrosion does not limit the use of the structural material X10 Cr Ni Ti 18 9 in a Na system, at least for 28,000 hours in high purity Na up to 600°C. Use of a stabilized stainless steel has decreased the C transfer problem, but grain boundary attack and sensitization in the outer diffusion layer cannot be prevented by the use of stabilized materials. Mass transfer causes migration of certain compounds around the system, and corrosion products become distributed throughout the cooling circuit during long term operation. Ca-bearing particles are detected in all parts of the loop piping, and the Ca content of the Na should be specified at very low values. (UK)

3847 INFLUENCE OF ALLOYING ELEMENTS ON THE CORROSION OF FERRITIC STEELS IN DYNAMIC SODIUM. Casteels, F.; Tas, H.; Cools, A.; Fevery-de Meyer, M. J. (SCK/CEN, Mol, Belg.). pp 245-249 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The single and combined effect of molybdenum, titanium, and titanium dioxide on the corrosion mechanism of Fe–13Cr base alloys in the Na_2 loop at S.C.K./C.E.N. Mol has been studied. The corrosion mechanism is found to be closely related to the diffusion of nickel, nitrogen, and carbon and the resulting formation of austenitic regions, stable carbides, nitrides, and carbonitrides. (auth)

3848 EFFECT OF SODIUM CLEANING AND SUBSEQUENT AIR STORAGE ON CLADDING MATERIALS. Casteels, F. (SCK/CEN, Mol, Belg.); Soenen, M.; Menken, G. pp 251-256 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

To investigate the extent of potential damage due to sodium cleaning, tests were performed with cladding tube samples which were cleaned by different methods after an integrated Na exposure of 3,000 hours under the conditions 973°K, 5 m/sec flow, and 6 ppM oxygen. A portion of the samples was removed, cleaned, inspected, and reinserted for 11 exposure intervals of 300 h each. The steam, alcohol, or water cleanings showed nearly no effects on the metal loss and selective corrosion, except that a predistillation induced a slightly deeper grain boundary grooving of a few micrometers. A distillation at 773°K resulted in a remarkable penetration of oxygen and sodium along grain boundaries into the material. Chromium, nickel, and even iron were leached out to the same depth. From burst tests at 973°K it can be postulated that the ferritic regions on the grain boundaries due to the selective corrosion process have the same effect as small cracks with the same depth. In the case of long-time air storage after sodium exposure the total selective Cr-, Ni-depleted region was damaged. (auth)

3849 CORROSION AND MASS TRANSPORT OF STEEL AND NICKEL ALLOYS IN SODIUM SYSTEMS. Thorley, A. W.; Ty-

zack, C. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 257-273 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Experiments were carried out to establish a relationship for the corrosion behavior of stainless steel in a flowing sodium environment as a function of the temperature of exposure, sodium velocity, or Reynold's number, oxygen level in the sodium, and time of exposure. The effects of altering sodium loop geometry, the alloy composition of the exposed materials, as well as the effect of flowing sodium on the corrosion behavior of the major alloying constituents of stainless steel, were also investigated, and current thoughts as to what role these major elements play in the corrosion process are presented. (auth)

3850 INTERSTITIAL ELEMENT MOVEMENT OF AUSTENITIC STAINLESS STEELS IN SODIUM. Borgstedt, H. U. (Kernforschungszentrum, Karlsruhe, Ger.); Grosser, E. D. pp 275-282 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Recent experiments to investigate the interstitial element transfer of SNR fast reactor fuel cladding materials in flowing sodium are summarized. A strong temperature dependence of interstitial migration was observed in a series of out-of-pile corrosion tests on nitrogen- and boron-alloyed austenitic stainless steels, and diffusion constants, calculated from the concentration gradients, are presented. The results of the post-irradiation examinations of the fuel cladding materials with regard to interstitials and the influence of interstitial elements on the mechanical properties of steels are discussed. (auth)

3851 CHARACTERIZATION OF INTERSTITIAL AND MINOR ELEMENT MASS TRANSFER IN SODIUM. Berkey, E.; Sweeney, C. G. (Westinghouse Research Labs., Pittsburgh). pp 283-288 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

A recently developed analytical technique, ion probe mass spectrometry, was applied to samples from a high temperature flowing sodium loop, operating non-isothermally with all austenitic stainless steel components, to characterize the distribution and mass transfer of some interstitial and minor elements. Carbon ion images from the wall of a loop hot leg sample showed definite differences in carbon distribution between depleted and nondepleted regions. The adherent cold leg deposits were observed to be rich in carbon and nitrogen, but no penetration of these elements into the sensitized structure of the steel substrate was visable. Silicon, aluminum, and sodium were other minor elements observed to be concentrated in the deposits. (auth)

3852 EFFECTS OF CORROSION PRODUCT TRANSPORT IN FAST REACTORS. Claxton, K. T.; Collier, J. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 289-300 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

During the operation of a fast reactor circuit, material is released from the cladding and structural materials to the circulating Na as a result of corrosion. From work carried out it is suggested that, under a range of temperatures typical of a commercial fast reactor (400 to 600°C) an average corrosion rate might be about 0.0025 mm/y at low oxygen levels. Thus a typical reactor with core surface area of 2000 m^2 would yield a material release rate of about 40 kg/y into 10^6 kg of Na, and it is important to obtain information on the subsequent behavior and fate of the released material. Any assessment of the amount of material released is dependent on the assumed levels of oxygen in the Na, but doubts must exist on the corrosion rate until a reactor unit of significant size is operating. It is necessary to establish the consequences of deposition on, for example, the performance of the heat exchange surfaces. Assessment of possible thermo-hydraulic effects requires information on deposit thickness, porosity, conductivity, and stability. The material released may be carried in the flowing Na both as dissolved species and as particulates. Factors, such as turbulence in the region of grids, must be considered. The minor constituents present in stainless steels are important, since they govern the induced activity levels. (UK)

3853 ESTIMATION OF THE RADIATION LEVELS NEAR THE COMPONENTS OF THE SNR-300 PRIMARY SYSTEM INDUCED BY DEPOSITION OF ACTIVE CORROSION PRODUCTS. Merkel, A.; Menken, G. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). pp 301-305 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is well known in reactor technology that radioactive corrosion products migrate within the coolant circuits. The radiation fields resulting from the deposition of these products can create maintenance difficulties. This has been found for water reactors and could also become a problem for breeder reactors, which employ high temperature sodium coolant. There are great uncertainties in predicting the radiation levels because of the lack of knowledge of the corrosion and deposition behavior of the most important radionuclides (^{58}Co, ^{60}Co, and ^{54}Mn). These activation products are mainly released from the cladding material at temperatures above 500°C. Using a uniform corrosion rate for all radionuclides, based on data taken from the literature, the calculations for the SNR-300 can be used to predict a saturation activity of free active corrosion products of about 2000 Ci. Three simple deposition models were employed to estimate the corrosion product distribution in the primary loop system. All models showed that the radiation levels of an empty heat transfer circuit may reach one R/hr near the unshielded main pipes and several R/hr near the unshielded pumps and IHX's. These are not unusually high radiation levels in comparison to those of water cooled reactor systems; however, they might well prove to be harmful when repairs become necessary. (auth)

3854 PROBLEMS OF CORROSION BY CONDENSATES AND VAPORS OF THERMAL AND NUCLEAR POWER PLANTS. Part 3. Bianchi, G. A.; Cerquetti, A.; Longhi, P.; Mazza, F.; Torchio, S. (Univ., Milan). Atti Notiz. (Publ. in Met. Ital.); 28: No. 11, 643-648(Nov 1973). (In Italian).

The corrosion mechanisms in condenser tubes are described in detail. These include galvanic corrosion, abrasion, corrosion by impingement, differential aeration, surface defects, corrosion by ammonia, and corrosion under pressure. (JSR)

3855 INVESTIGATION OF HYDRAULIC RESISTANCE IN TUBES WITH GRAINED ROUGHNESS. Millionshchikov, M. D.; Subbotin, V. I.; Ibragimov, M. Kh.; Taranov, G. S.; Gomonov, I. P. At. Energ. (USSR); 36: No. 3, 186-188(Mar 1974). (In Russian).

Experimental data on resistance coefficients for tubes with roughness caused by grains of river sand and abrasive cloth in the region of Reynolds numbers of 4×10^3 to 1×10^6 are presented. In contrast to tubes with geometrically strict, regular roughness there exists a quadratic resistance regime at high Reynolds numbers. The conditions for the onset of the quadratic regime are examined. (tr-auth)

3856 INFLUENCE OF STRESS CONCENTRATION ON THE MECHANICAL PROPERTIES OF PROTECTIVELY COATED MOLYBDENUM SAMPLES DURING TESTS IN AN OXIDATIVE MEDIUM. Zelenyuk, E. E.; Shkoliar, V. S.; Sosnovskii, L. A.; Epik, A. P. (Inst. of Prognosis Problems, Kiev). Probl. Prochnosti; 5: 56-59(Sep 1973). (In Russian).

3857 STRESS-RUPTURE TESTING OF TUBING UNDER SUPERIMPOSED STEAM CORROSION ATTACK. Experimental Set-Up, Method, and Results of Incoloy Alloy 800 Tube Long-Time Testing. Leistikow, S.; Kraft, R.; Jennert, D. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Werkstofftech.; 5: No. 1, 34-41 (Jan 1974). (In German).

A special experimental set-up was built for long-time stress-rupture testing of tubing under biaxial stresses and superimposed steam corrosion attack. The principles of its construction and the testing method applied, but also the results of Incoloy 800 thin-wall tube testing at constant load, pressurized with argon or steam, are described. At 650 and 700°C the mechanical properties (strength and ductility) were not influenced by the superimposed corrosion attack. The increase in surface and bulk oxidation, varying with the stress level, is explained by the influence of creep rate and the state of surface oxidation at the time of exposure when the tertiary creep is beginning to be effective. (GE)

3858 ELECTRON WORK FUNCTION OF TUNGSTEN-(100)-VICINALS. Koerner, W. (Univ., Marburg, Ger.). Phys. Status Solidi (a); 22: No. 2, 523-534(16 Apr 1974). (In German).

A statistical method for the determination of the dependence of the electron work function of vicinal faces on the angle of inclination ψ is described. In order to apply this method to the W-(100)-vicinals, the orientation distribution of a recrystallized surface is determined. The electron emission differences between the crystallites and the effective work function resulting from the surface ionization coefficient of potassium were measured by a thermal emission microscope. On setting up $\Phi = \Phi_{100}(1 - K\psi^2)$, $\Phi_{100} = (4.59 \pm 0.03)$ eV and $K = 0.35\ (1 \pm 24\%)$ for $\psi \leq 0.1\ \pi$ is obtained. A simple extension of the Albrecht theory for the case of vicinal faces leads to a result which agrees well with this experimental result. (7 fig) (auth)

3859 EFFECT OF THE STATE OF THE ZIRCONIUM SURFACE ON THE STRUCTURE AND PROTECTIVE PROPERTIES OF OXIDE FILMS FORMING A CORROSIVE ENVIRONMENT. Korobkov, I. I. Sov. J. At. Energy (Engl. Transl.); 34: No. 3, 142-143 (Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 112-113(Feb 1973). This is a summary of paper No. 647/6685 with full copy held by TIC.

Results of the investigation show that the mechanism by which the oxygen, nitrogen, chlorine, and fluorine effect the process of zirconium oxidation exhibits a general physicochemical nature: all of these elements, when present on the surface of the specimen, have the effect of increasing the chemical inhomogeneity of the metal and bringing about nonuniform oxidation of grains, so that coherent bonding between the ZrO_2 crystal grains and the metallic zirconium is impaired and the grain size of the crystals ends up reduced. As the crystal grains undergo reduction in size, they may also experience a change in structure from monoclinic to tetragonal or cubic, accompanied by a corresponding reduction in the specific volume occupied by the ZrO_2. This transformation may well be the reason for the formation of pores sized 10 to 15 Å, observed in oxide films on zirconium. When the number of pores in the film is sufficiently great, molecular oxygen becomes capable of penetrating through to the metallic zirconium substrate. (auth)

3860 CORROSION: STUDY AND EXAMINATION OF IRRADIATED MATERIALS. Berry, J. L.; Dixmier, J. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 188, 39-42(Jan 1974). (In French).

Corrosion prevention studies involve the sampling and examination of various metallic parts whose radioactivity exclude classical laboratory procedures. The samples and parts considered originate from chemical processing plants or from nuclear reactors (structural or fuel elements). Investigations of the effect of neutron irradiation on corrosion phenomena necessitate the handling of large numbers of activated and nonactivated samples. Work undertaken by the Irradiation Laboratory of the Corrosion and Electrochemistry Research Service (Saclay) is discussed. The methods and facilities employed are briefly reviewed. (FR)

Preparation and Fabrication

3861 (CONF-710342-, pp vp Paper 4) FABRICATION DATA RELATIVE TO THE A508, CLASS 2 FORGINGS FOR THE HSST INTERMEDIATE TEST VESSELS. Childress, C. E. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The HSST program has planned a series of tests involving pressure vessels of intermediate size. The vessels will be 6 in. thick × 39 in. OD × about 7 ft in overall length. Each will be fabricated from ASTM A-508 Class 2 sub-assemblies. One vessel will be provided with a 9 in. ID nozzle, and, among the vessels, certain parameters such as types of welds and weld location will be selectively varied. Also, each vessel will be provided with artificially induced flaws of varying size, configuration, and location. The vessels will serve as test specimens for demonstrating the capability to predict safe behavior of thick-wall pressure vessels containing flaws of known dimensions under frangible, transitional, and tough loading regimes. Each vessel will serve as a go, no-go determination of critical flaw size for a specific set of test parameters. Fabrication of the vessel components was sub-let to two forging manufacturers; one vendor made the flat and hemispherical heads, and another the weld test plate, the transition sections, and the shell sections. Histories of these components, including melting, heat treatment, machining, and inspection (where completed) are presented. Mechanical test data representing each item are also given. Atypical mechanical properties (tensiles in excess of 105 ksi and yields of the order of 85 to 88 ksi) were reported for the shell courses. Coincidentally, the yield strength reported for the shell courses is about the anticipated ultimate tensile strength of the vessel welds. It thus became necessary to retemper the shell courses at a higher temperature in an effort to lower the mechanical properties of the shell courses. The data derived from tests to determine the optimum tempering temperature are included. Heat treatment data and the mechanical test results for the first shell course to be retempered are also included. (auth)

3862 (CONF-710342-, pp vp Paper 5) HEAT TREATMENT STUDY FOR INTERMEDIATE TEST VESSELS. Berggren, R. G.; Stelzman, W. J. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Specimen materials from an intermediate test vessel forging were subjected to heat treatments simulating the possible retempering cycles that could be applied to the intermediate test vessels. A restricted range of tempering temperatures was defined which produces the desired reduction of strength without serious deterioration of notch-impact properties. (auth)

3863 (CONF-710342-, pp vp Paper 6) METALLURGICAL ASSESSMENT OF RETEMPER TEMPERATURE ON THE INTERMEDIATE VESSEL TEST COURSES. Canonico, D. A. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Heat-treating studies employing the Data-Trak have provided mechanical property data for a heat (National Forge Heats 3V913 and 1V3809) of ASTM A 508, Class 2 steel. This material was previously heat treated by quenching in water from 1580°F and tempering at 1270°F for 6 h. The resulting mechanical properties were beyond those that would be projected by state-of-the-art predictions. In an effort to bring these properties in line, an investigation of retempering treatments were conducted. A metallurgical investigation of the as-received forging and the subsequent reheat treatments was conducted. It was found, through a cursory hardness study, that transformation upon heating occurs between 1310 and 1325°F. A resistivity study employing specimens from the subject heat of steel showed that the eutectoid temperature is between 1315 and 1346°F. In view of these results, the retemper treatments conducted at 1320 to 1340°F probably result in the reaustenitization of regions within the microstructure of this steel. Light microscopy studies of microstructural samples taken from the Charpy specimens show a similarity between the steel tempered at 1280°F and those tempered between 1300 and 1340°F. Further, the results of the resistivity study on material austenitized at 1562°F and isothermally transformed at 1202°F and the as-received material (quenched from 1580°F and tempered at 1270°F) imply that there is very little difference in the volume percentages of ferrite and carbide in these two structures. (auth)

3864 (IS-T-613) PYROMETALLURGICAL SEPARATION OF URANIUM FROM $(Th,U)O_2$ SOLID SOLUTIONS. Jha, M. C. (Ames Lab., Iowa (USA)). Mar 1974. Contract W-7405-eng-82. 119p. Dep. NTIS $9.00.

Thesis.

Thorium metal was used to reduce UO_2 to metallic uranium in presence of fused KCl–LiCl or NaCl–$MgCl_2$ eutectic containing $ThCl_4$. The equilibration was carried out in tantalum crucibles in a rocking furnace at 500 to 700°C. X-ray diffraction techniques were used for identification of the reaction products and analysis of the oxide phase. Salt samples were chemically analyzed. The solubility of UO_2 is small in both eutectics. Presence of $ThCl_4$ helps in dissolving the oxide by forming $UOCl_2$ and $ThOCl_2$. Thorium can replace uranium from $UOCl_2$. The two oxychlorides are only sparingly soluble in the salts used and dissociate to oxides and tetrachlorides. Thorium metal does not reduce $ThCl_4$ to $ThCl_3$ or $ThCl_2$. UCl_4 is reduced to UCl_3 and to metallic uranium by an electrolytic mechanism which involves dissolution of an equivalent amount of thorium as $ThCl_4$. Thus $ThCl_4$ is not consumed in the process and acts as an intermediate. The dissolution of the oxide is probably the slow step and high $ThCl_4$ concentrations may be needed for $(Th,U)O_2$ solid solutions with low UO_2 content. The equilibrium UO_2 content of the resulting oxide phase depends upon the concentration of UCl_4, UCl_3, and $ThCl_4$ in the salt phase from which oxide precipitates as fine powder. The ratio X_{UO_2}/X_{ThO_2} of the oxide phase decreases with decreasing amount of UCl_4 and under extremely reducing conditions when metallic uranium is formed, the UO_2 content of the oxide should be a few ppM or less. A higher amount of uranium is retained in the salt phase at higher $ThCl_4$ concentrations. (auth)

3865 (Y-1931) CAST COMPOSITE ELECTRODES FOR ARC MELTING A URANIUM–NIOBIUM–ZIRCONIUM ALLOY. Hackett, D. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 29 Mar 1974. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

Composite electrodes have been arc melted to form ingots of the uranium–7½ niobium–2½ zirconium alloy (Mulberry). These electrodes were produced by casting uranium around strips of niobium and zirconium. This alloy has been compared analytically with Mulberry produced by arc melting using elemental strip electrodes. The cast electrode produced alloy well within the required limits and is chemically equal to, and possibly superior to, alloy using a strip electrode. (auth)

3866 HOW MANGANESE AND BORON AFFECT MEDIUM-CARBON STEELS. Woodyatt, L. R.; Apple, C. A. (Bethlehem Steel Corp., PA). Metal Progr.; 105: No. 5, 82-83(May 1974).

Both Mn and B act to slow transformation of austenite to pearlite and ferrite, thus allowing bainite and martensite to form at lower cooling rates and imparting increases in hardenability. Continuous cooling transformation diagrams are presented for AISI 1040, 1541, and 15B41 steels. (DLC)

3867 EVAPORATION SOURCE FOR ^{57}Fe THIN FILM DEPOSITION. Keune, W. (Univ., Saarlandes, Saarbruecken, Ger.). Nucl. Instrum. Methods; 116: No. 3, 591-592(1974).

A simple electron-beam heated furnace is described which allows the controlled evaporation of small quantities of isotopes, particularly of ^{57}Fe, for thin film deposition. (auth)

3868 METHOD OF PRODUCTION OF ALKALI METALS AND THEIR ALLOYS. Tobias, C. W.; Jorne, J. (to United States Atomic Energy Commission). US Patent 3,791,945. 12 Feb 1974. Filed date 22 Feb 1973. 6p.

An impure amalgam of an alkali metal or mixture thereof is produced by electrolysis. The amalgam is then transferred to an electrolytic cell containing propylene carbonate with an appropriate salt (or salts) of the alkali metal (or metals), e.g., of ClO_4^-, BF_4^-, PF_6^-, Cl^-, Br^-, I^-, with or without added $AlCl_3$. Then, with appropriate voltage, current and other conditions, one or more selected alkali metals is anodically dissolved to yield a pure metal or selected metal mixture by electrodeposition. (Official Gazette)

3869 PROCESS FOR PRODUCING Zr OR Zr-BASE ALLOY TUBE FOR NUCLEAR FUEL ELEMENT SHEATH. Nishihara, M.; Yamamoto, S.; Nagai, N.; Fujita, T.; Kakuma, T. (to Kobe Steel Ltd.). Japanese Patent 1973,20984. 24 Oct 1968. 3p. (In Japanese).

A process for producing a nuclear fuel sheath of Zr or Zr-alloys comprises the step of extruding a blank through the die in the medium of pressurized liquid under the condition of R value 30% and Q value 1.5, where R is a surface area reduction ratio and Q is defined by the equation: thickness before working—thickness after working/thickness before working/outside diameter before working—outside diameter after working/outside diameter after working. As the ideal deformation takes place in the pressurized hydraulic medium, so the aggregate structure of the material is improved in such a manner that the surface tubes is roughly parallel to 0002 face. Although any extrusion process can be employed in the combinations of dies and mandrels, it is preferable to use the method of expanding the inside diameter of the blank while reducing the outside diameter in order to improve the aggregate structure. In one embodiment, a billet of a zirconium alloy (Zircaloy) containing 0.12% Fe, 0.1% Cr and 0.05% Ni is hot-extruded, annealed at 750°C for 1 h, then molded under the hydraulic pressure of 7,100 kg/cm^2, R-value 38% and Q-value 0.3. The structure of the tube has highly aggregated on the 0001 face, showing superior mechanical and directional properties. (JA)

3870 BRAZING OF A DISPERSION STRENGTHENED NICKEL BASE ALLOY MADE BY MECHANICAL ALLOYING. Kenyon, N.; Hrubec, R. J. Weld. J. (N.Y.); 53: No. 4, 145-s-152-s(Apr 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

Joining of a dispersion strengthened alloy made by a new process called mechanical alloying is discussed. This process makes it possible for the first time to produce alloys with the long sought combination of dispersion strengthening and age hardening. A brief review of the joining of dispersion strengthened materials and of the difficulties of arc welding them is included. The results of a brazing program are reported. Thirteen brazing alloys, some commercial and some experimental, were examined. Brazing was carried out in dry hydrogen and in a vacuum. Evaluation of the brazed joints consisted of x-radiography, metallography, elevated temperature tensile testing, and high temperature oxidation resistance. Both single lap and Miller–Peaslee specimens were tested. It is shown that brazed joints with 1900°F tensile strengths corresponding to approximately 80% of base metal strength can be made with commercial and experimental brazing alloys. Oxidation resistance similar to that of the sheet can also be achieved. Brazing must be done in vacuum because flow of the brazing alloy does not occur in dry hydrogen. (auth)

3871 TLP BONDING: A NEW METHOD FOR JOINING HEAT RESISTANT ALLOYS. Duvall, D. S.; Owczarski, W. A.; Paulonis, D. F. (Pratt and Whitney Aircraft, Middletown, CO). Weld. J. (N.Y.); 53: No. 4, 203-214(Apr 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

TLP bonding process is described. This process is used to produce high-strength diffusion bonds in heat resistant materials without the need to apply substantial pressure during bonding. The process uses a mating surface interlayer alloy which temporarily melts and then resolidifies at the bond temperature to form a joint whose characteristics resemble those of a solid state diffusion bond. With this bonding method, joints can be made in complex shaped parts using simple tooling and mating surface preparation. Bonding is conducted in conventional vacuum or argon atmosphere heat treating furnaces so that large numbers of parts can be bonded in each process cycle. Bonds have been achieved in a variety of nickel base superalloys and between dissimilar metal combinations including nickel-to-cobalt alloys. Bond strengths equivalent to base metal values have been achieved even in high temperature stress-rupture testing. The characteristics of the process, and the microstructure and mechanical properties of bonds made in various similar and dissimilar alloy combinations, are described. (auth)

3872 BERYLLIUM APPLICATIONS IN SPACECRAFT STRUCTURES. Switz, R. J. SAMPE Quart.; 5: No. 3, 39-43 (Apr 1974).

A number of spacecraft that use beryllium as the primary structural material have been built. Several problems have been encountered related to inexperience in both the design and manufacturing areas. These problems are reviewed from a cause-and-effect relationship, and specific instances are discussed. Future applications are projected, together with some comparisons to more conventional structural materials, including cost parameters. (9 figures) (auth)

3873 POWDER METALLURGY AND THE SUPERALLOYS. Kelley, E. W. (Cabot Corp., Kokomo, IN). Int. J. Powder Met. Powder Technol.; 10: No. 1, 53-58(Jan 1974).

Progress in the perfection of techniques for making powder metallurgy (PM) parts in the nickel-, cobalt- and iron-base superalloys has been slow due to the inherent difficulty in consolidating these alloys into the almost fully dense material that is necessary to meet the stringent property requirements demanded. Progress is now being made, however, in applying PM techniques to heat- and wear-resistant superalloys. As superalloys of greater complexity are designed to meet the demand for materials to operate in more severe environments, PM techniques are expected to be the only means by which some of these can be made into usable hardware. (auth)

3874 RECENT ADVANCES IN BRAZING. Slaughter, G. M.; Werner, W. J.; Gilliland, R. G.; Hammond, J. P. (Oak Ridge National Lab., TN). SAMPE Quart.; 5: No. 3, 10-16(Apr 1974).

Recent advances in the development of filler metals for brazing aluminum, refractory metals, and ceramics are described. A unique, brazed powder-metallurgy transition joint for attaching graphite to structural metals is also discussed. (8 figures) (auth)

3875 JOINING CERAMICS TO METALS AND OTHER MATERIALS. Pattee, H. E. (Battelle Columbus Labs., OH). Weld Res. Counc. Bull.; 1-43(Nov 1972).

A survey was conducted of the history and present state of the technology of ceramic-to-metal seals and joints, with special attention to its significance for the electronics industry, still its largest user. Following a materials review covering beryllia, magnesia, thoria, zirconia, as well as refractory, electrical, and mechanical ceramics, a discussion of commercially available noble filler metals is presented in terms of their service properties, wetting, flow, and melting characteristics, reactions during brazing, and economics. Problems of joint design and configuration and those of ceramic surface preparation, cleaning, and metallizing are considered, along with the mechanical, electrical, and thermal tests used in the evaluation of joints. A description of theories of ceramic-to-metal joining covers the alumina-reaction, molybdenum oxide, glass migration, and other theories and adherence mechanisms, including wetting and ceramic-metal interface reactions. A review of brazing ceramic-to-metal joints and seals and of some other fabrication methods, such as fusion and solid-state joining, electroforming, and soldering, concludes the survey. (IAA)

3876 As-CAST, RARE-EARTH-Co–Cu PERMANENT MAGNET MATERIAL. Tawara, Y.; Senno, H. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,790,414. 5 Feb 1974. Priority date 15 Nov 1967, Japan. 10p.

Permanent magnet material having a high coercive force and a high residual flux density is constituted by an alloy of cerium (15 to 20 mol percent), cobalt (52 to 77 mol percent) and copper (8 to 30 mol percent). The cerium can be replaced by Ce–mischmetal in an amount providing the equivalent quantity of cerium. The material has a novel microstructure. The material can be prepared by melting together the ingredient materials and furnace-cooling to room temperature. Superior results are obtained with specially scheduled heat-treatments including controlled cooling rates. It is not necessary to use fine particle magnet material. (Official Gazette)

3877 GROWTH OF ZIRCONIUM SINGLE CRYSTALS. Dickson, J. I. (Ecole Polytechnique, Montreal); Craig, G. B. Can. Met. Quart.; 12: No. 3, 271-280(1973).

The growth of zirconium single crystals by three different techniques was studied. For crystals grown by passing samples through a steep temperature gradient in an electron beam furnace, it is shown that there is preferred growth when the $\langle 11\bar{2}1 \rangle$ direction in the beta phase which transforms to a $\langle 1\bar{2}10 \rangle$ direction in the alpha phase is almost parallel to the longitudinal temperature gradient. Large crystals were also grown by cycling samples through the transformation temperature followed by long annealing just below this temperature and by strain-annealing. For these latter techniques, evidence is presented to show that crystal growth proceeds to reduce the amount of substructure present. (auth)

3878 ELECTRON BEAM SCAN MELTING OF URANIUM ALLOYS. Irwin, G. J. (Defence Research Establishment, Ottawa); Goldak, J. A. (Defence Research Establishment, Ottawa). Can. Met. Quart.; 12: No. 3, 355-357(1973).

Dilute uranium alloys of moderately high hardness tend to be highly unstable mechanically, particularly if the microstructure is martensitic. Cylindrical tensile specimens of U–0.9 Mo–1.2 Nb–1.0 Zr and U–2 Mo were surface treated by electron beam scan melting in an attempt to produce a beneficial diffuse structure. Tensile tests indicate some improvement in strength at the cost of some ductility. (CA)

3879 SURVEY OF FUTURE PRODUCTION OF ZIRCON AND ZIRCONIUM IN AUSTRALIA. Aust. Miner. Ind.; 26: No. 1, 13-38(Sep 1973).

The situation in Australia concerning reserves, production, and prices for zircon is reviewed and methods used for the production of zirconium sponge and tubing including likely new developments, are described. Estimates for world requirements for zirconium are given, and comments on the broad possibility of producing zirconium sponge and tubing for Australian consumption or export overseas are included. (AT)

3880 PREPARATION AND PROPERTIES OF PROMETHIUM METAL. Wheelwright, E. J.; Chikalla, T. D. (Battelle Pacific Northwest Labs., Richland, WA). pp 259-281 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

A comparatively small amount of research has been reported on the preparation of promethium in the metallic state. Three separate groups of researchers have reported on the preparation of promethium metal by reduction of the fluoride, the chloride, and directly from the sesquioxide. These efforts are reviewed in chronological order in this chapter. Very little work has been reported on the properties of promethium metal because of the very limited amount produced to date; all of the known property measurements are reported in this chapter. (auth)

3881 HOT PRESS AND ROLL WELDING OF Ti–6Al–4V WITH AUTO-VACUUM CLEANING. Holko, K. H. (Lewis Research Center, Cleveland). Weld. J. (N. Y.); 53: No. 5, 219-s-224-s(May 1974).

Hot press butt welds were made in 13 mm dia Ti–6Al–4V bar, and roll lap welds were made in 1.5 mm thick Ti–6Al–4V sheet. The faying surfaces of all weld specimens were seal welded at their peripheries prior to either hot press or roll welding. Some of the weld specimens were also given an auto-vacuum cleaning treatment at 980°C before welding. The auto-vac cleaning treatment dissolved the oxides from the faying surfaces into the base metal. Solid state welding occurred when the mating surfaces were brought into contact. Weld specimens were evaluated metallographically and by room temperature tensile testing. Excellent hot press butt welds were produced in Ti–6Al–4V bar by first auto-vac cleaning at 980°C for 2 h and then hot pressing at 955°C for 5 min with a pressure of 1.38 MN/m^2. The time required for welding (5 min) was greatly reduced from conventional diffusion welding practice (60 to 180 min) due to the prior auto-vac cleaning treatment. A deformation of about ½% took place at the weld. Metallographic examination showed that grain growth across the weld line eliminated all evidence of the weld interface. Room temperature tensile tests of the butt welds resulted in base metal strength and ductility. It was also found that while strength values for poor quality solid state welds could be high, the elongation and reduction in area values were invariably low. But in high quality welds, the ductility values were also high. Thus, it is apparent that both strength and ductility values must be considered in judging weld quality. High quality roll welds were made in Ti–6Al–4V sheet with as little as 10% deformation at 955°C. This was an improvement over the 60% deformation commonly used. The auto-vac cleaning treatment was not necessary to achieve this result, although the seal weld was. It is felt that the auto-vac phenomenon occurred during heat-up to the rolling temperature, during rolling, and during cool-down from the rolling temperature. (auth)

3882 WELDING STUDIES ON ARC-CAST MOLYBDENUM. Moorhead, A. J.; Slaughter, G. M. (Oak Ridge National Lab., TN). Weld. J. (N. Y.); 53: No. 5, 185-s-191-s(May 1974).

From 54th annual AWS meeting; Chicago, IL (2 Apr 1973).

Although molybdenum has several metallurgical characteristics that make its fabrication (especially by welding) difficult, it has some important properties that give it good potential for use in the next generation of nuclear reactors or in radioisotope thermoelectric generators. To increase our understanding of the characteristics that have limited the use of molybdenum, a program was undertaken in support of the Molten Salt Breeder Reactor in which very complex prototype components for a chemical processing test stand were fabricated from arc-cast molybdenum by extrusion, machining, welding, and brazing. Results of the welding development portion of that program are presented. Procedures were developed for cleaning and stress-relieving this material before welding and for making helium-leak-tight welds by both the gas tungsten-arc and electron beam processes. A commercial orbiting-arc weld head was modified so that molybdenum tubing could be field joined outside the space limitations of a glove box. Using a combination of many procedures and processes, several 3.875 in. dia cylindrical vessels were fabricated, thus demonstrating the feasibility of constructing complex structures from molybdenum. (auth)

3883 METHOD OF PRODUCING AN ULTRA-CLEAN, BRIGHT SURFACE ON TITANIUM. Katz, O. M.; Campbell, C. E. (to United States Atomic Energy Commission). US Patent 3,795,597. 5 Mar 1974. Filed date 15 Mar 1973. 4p.

An invention is described that relates to the treatment of titanium or titanium-base alloy articles for the purpose of effecting an ultra-clean, bright surface thereon. The method involves treating the surface with a solution of methyl alcohol, sulfuric acid, and hydrofluoric acid which is maintained at about –45°C and through which is passed an electric current. (Official Gazette)

3884 HEAT TREATMENT RESPONSES OF THREE COMMERCIAL Ti ALLOYS. Fopiano, P. J.; Hickey, C. F. Jr. (Army Materials and Mechanics Center, Watertown, MA). J. Test. Eval.; 1: No. 6, 514-519(Nov 1973).

Similarity is shown between the heat treatment responses of Ti–6Al–4V, Ti–6Al–6V–2Sn, and Ti–8Al–1Mo–1V. Two hardening mechanisms can account for most of the responses to heat treatment. The changes in strength as the result of heat treatment are correlated with the equilibrium alloy contents of the phases present at the solution temperature. (6 fig) (auth)

3885 STATUS OF POWDER METALLURGY IN AUSTRIA. Sedlatschek, K. (Metallwerk Plansee, Tyrol, Austria). Int. J. Powder Met. Powder Technol.; 10: No. 2, 77-80(Apr 1974).

This brief review covers Mo, W, Ta, Nb, their alloys, cemented carbides, sintered iron and steel, seminars, and research. (DLC)

3886 HOT PRESSING OF TITANIUM AEROSPACE COMPONENTS. Malik, R. K. (General Dynamics, San Diego, CA). Int. J. Powder Met. Powder Technol.; 10: No. 2, 115-134(Apr 1974).

This paper covers the producibility of titanium powder metal shapes for aerospace structural applications by the Convair Aerospace hot-pressing process. Four complex fittings, each nine inches square with 1.5-inch-deep pockets, and different wall thicknesses and radii, were hot pressed from Ti–6Al–4V powder with reusable tooling in a hydraulic press. The hot-pressed parts had fine grain sizes, a hardness of 30 R_c, and densities as high as 99.5%. Mechanical properties were equivalent to wrought titanium. Hot-pressing can provide major cost savings for producing complex titanium alloy parts by reducing expensive machining and by material economies of 70% to 80%. Joints are also eliminated with the process. (16 fig) (auth)

3887 PROCESSING OF CONTACT MATERIALS USING CHEMICAL VAPOR DEPOSITION. Ruthardt, R. (Heraeus (W. C.) GmbH, Hanau, Ger.); Elssner, G. Metall; 28: No. 1, 28-31(Jan 1974). (In German).

Ductile, adhesive, high-purity molybdenum contact layers can be deposited on soft magnetic iron-nickel alloys by means of hydrogen reduction of molybdenum pentachloride at temperatures between 900 and 950°C, which are equal in quality to the layers produced by vacuum physical vapor deposition. At reaction temperatures of 1000°C and above, however, a brittle, less adhesive intermediate layer is formed during the CVD process between the contact material and the substrate. (GE)

3888 PREPARATION OF NIOBIUM–LEAD COMPOUNDS. Morton, N. (Univ. of Salford, Eng.). Cryogenics; 14: No. 4, 224 (Apr 1974).

Niobium compounds frequently possess an almost unique combination of both very high superconducting critical temperature and critical field. Approximately equal weights of 99% pure niobium powder and clippings from lead sheet of laboratory reagent quality were sealed under vacuum in fused-quartz tubing and placed in a conventional furnace. The temperature was increased to approximately 1,050°C and held constant for 48 hours; the tube being moved occasionally to encourage beads of molten lead clinging to the tube walls to mix with the niobium powder. The furnace was then allowed to cool, and the tube was removed when the temperature had fallen to approximately 600°C and air-cooled. Appreciable amounts of lead remained condensed on the tube walls; however, the bulk had been absorbed by the niobium powder, as shown by appropriate weighing. A preliminary analysis of x-ray diffraction pattern obtained indicates the presence of three compounds. The bulk of the lines can be accurately indexed to either a simple cubic cell with $\alpha = 4.21$ Å, or a tetragonal cell with $\alpha = 4.63$ and $c = 5.95$ Å respectively, or to free lead. (UK)

Properties, Structure, and Phase Studies

Refer also to abstracts 2629, 2982, 3816, 4416, 5159, 5535, 5614, and 5731.

3889 (AD-763429) DEFORMATION AND SOLID SOLUTION STRENGTHENING OF Ti–V ALLOYS. Summary Report. Baggerly, R. G.; Paton, N. E.; Williams, J. C. (North American Rockwell Corp., Thousand Oaks, Calif. (USA)). 29 Jun 1973. Contract N00014-71-C-0363. 35p. NTIS $3.00.

The deformation and aging characteristics of Ti–V alloys and Ti-12.5% Mo alloy were investigated. Single crystals of Ti–30V, Ti–40V and Ti-12.5 Mo were used to study deformation behavior for the solid solution condition and after an aging treatment. The critical resolved shear stress for slip or twinning was determined as a function of temperature for these crystals. Optical trace analysis was used to identify the active slip or twinning plane and thin foil electron microscopy was used to identify aging products. X-ray precession camera techniques were occasionally used to corroborate results. Tests were also conducted to determine the effect of grain size on yield stress and work hardening behavior in Ti–20V, Ti–30V, and Ti–40V alloys. (GRA)

3890 (AD-766214-1) PHYSICAL METALLURGY BASIS FOR ACHIEVING 300-ksi STRENGTH IN TRANSAGE TITANIUM ALLOYS. Final Report, 14 Oct 1971–14 August 1973. Crossley, F. A. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Aug 1973. Contract DAAG46-72-C-0016. 77p. (AMMRC-CTR-73-28). NTIS $3.75.

Four martensitic-titanium alloys: Transage 117 (Ti–2.5 Al–14.5 V–5Sn–7Zr), Transage 120 (Ti–3Al–15.5V–5Sn–10Zr), Transage 129 (Ti–2Al-11.5V–2Sn–11Zr) and Transage 134 (Ti–2.1 Al–11.9V–2Sn–6Zr) were studied metallographically to determine their microstructural characteristics in beta-annealed and alpha-beta-annealed conditions. Thin-foil electron transmission was the principal metallographic means because the athermal martensite of these alloys is of the order of 10 Å in thickness. The alloys undergo stress induced transformation in the annealed condition and possibly they experience this phenomenon in some age hardened conditions. The annealed conditions were starting states for thermomechanical treatment (TMT) studies for achieving 300 kip/in^2 strength. The strength goal seemed inherent in a number of the combinations of alloy and TMT schedule. Confirmation of the strength goal was not realized due to deficiencies in test specimens design and condition, and in the quality of machining. The fracture surfaces suggest that the materials have sufficient ductility to demonstrate the yield strength goal of 300 kip/in^2. (GRA)

3891 (AD-769343) SOLID SOLUTION SOFTENING (RHENIUM DUCTILIZING EFFECT AND BUBBLE STRENGTHENING IN TUNGSTEN–RHENIUM ALLOYS). Technical Report, 15 October 1969–15 October 1972. Simpson, R. P. (Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Sep 1973. 165p. (AFML-TR-73-235). NTIS $4.75.

The effect of carbon additions to tungsten and tungsten–rhenium alloys was determined by anelastic relaxation, stress relaxation, and mechanical property studies. Rhenium alone, rather than a combination of rhenium and interstitials, lowers the lattice friction stress (Peierls stress) and is responsible for the ductilizing effect in tungsten. Bubbles were identified at grain boundaries of recrystallized, doped tungsten and tungsten–rhenium alloys from scanning electron microscopy studies of intergranular fracture surfaces. Auger electron spectroscopy demonstrated that these bubbles are coated with potassium which is highly localized at grain boundaries. Varying concentrations of rhenium had no noticeable effect on fracture behavior, bubble size or distribution, or potassium segregation. The bubbles dramatically raise recrystallization temperature and control grain growth texture and are, therefore, responsible for the high temperature creep properties of "doped" tungsten and tungsten–rhenium alloys. (GRA)

3892 (AE-486) HIGH CYCLE FATIGUE CRACK GROWTH OF TWO ZIRCONIUM ALLOYS. Rao, V. S. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Mar 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

High-cycle fatigue crack growth rate behavior at room temperature was analyzed on the basis of fracture mechanics for Zircaloy-2 and Zr–2.5% Nb sheet materials. The effect of hydrides, about 300 ppM H, was investigated. It was found that the crack growth rate could be represented by a power rate law of the type $(da/dN) = C(\Delta K)^n$ where (da/dN) is the rate of growth, ΔK the stress intensity range, C and n are constants. A value of 3 for n was found to hold for all the materials. The total effect of H was to increase the crack growth rate by increasing C but not n. The rate was higher for hydrided Zr–Nb alloy than for the corresponding Zircaloy-2 at a particular stress level. Threshold ΔK or $\Delta\sigma$ values where no crack propagation occurred at any measurable rate were obtained. There were no appreciable differences between the two alloys. Zr–Nb alloy, despite higher strength, was not better in this respect either. Furthermore, it was found that Zr–Nb alloy, at least in the present solution-treated and aged condition and especially in the hydrided state, has less fracture toughness than Zircaloy-2, since the extent of crack propagation before final failure is much less. Fractographic observations confirmed this conclusion. (9 figures, 2 tables) (auth)

3893 (AERE-R-7631) STRUCTURES AND MECHANICAL PROPERTIES OF VACUUM AND AIR-MELTED CASES OF HASTELLOY-X. Arkell, D. R.; Roberts, A. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

Hastelloy-X in its low-cobalt form is of interest as a potential cladding material for HTGRs. The tensile strength at 750°C of the vacuum-melted alloy is marginally lower than that of the air-melted material; however, its tensile ductilities in the annealed and aged, and cold worked and aged conditions are significantly higher. In stress rupture tests at 750°C, tertiary creep occurs much earlier in the air-melted material in the 15% cold-worked condition than in similar specimens of the vacuum-melted alloy; however, the solution-treated specimens of both casts behave similarly. No significant differences in the microstructures of the two casts were observed to account for the differences in tensile ductilities. It is possible that these may be due to the different nitrogen contents of the alloys, which are 0.002% and 0.028% in the vacuum and air-melted alloys respectively. (auth)

3894 (CEA-CONF-2589) CHARACTERIZATION OF THE SOLID–SOLID DIFFUSION BY IONIC PROBE. Blanchard, B.; Bonis, M.; de Erebisson, M.; Monnier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 7 Aug 1973. 24p. (In French). (CONF-720990-11). Dep. NTIS (US Sales Only) $4.25.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

Within the framework of a general study on the problem of the characterization of solid–solid diffusion, an investigation was made to determine the base models and the parameters corresponding to existing physical phenomena such as the law of variation of the diffusion coefficients, exchange at the oxide–silicon interface, and interactions between diffusions of opposed types. The results obtained during a first approach to the problem are reported. Typical diffusion curves obtained for arsenic in complex oxide deposits containing SiO_2–GeO_2–As_2O_3–B_2O_3 are reported. The analysis techniques are illustrated by studying the impurity profiles of Ge, As, and B at the SiO_2–Si interface. Profiles obtained by numerical simulation with the DIFFUSI program are compared with experimental results. (JSR)

3895 (CISE-N-165) INITIAL ACTIVITY IN THE STUDY OF ORIENTED EUTECTIC SUPERALLOYS FOR USE AT HIGH TEMPERATURE. Bassi, A.; Be, C. A.; Camona, G. A.; Wenger, D. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1973. 30p. (In Italian). Dep. NTIS (US Sales Only) $4.50.

Initial results are given of the study of the oriented eutectic superalloy Ni–Ni_3Ta, intended as a base material for gas-turbine blades with a characteristic operating temperature above 1000°C. Morphological and structural analyses were made of the alloy. (JSR)

3896 (CONF-710342-, pp vp Paper 1) FATIGUE CRACK GROWTH CHARACTERISTICS OF NUCLEAR PRESSURE VESSEL GRADE MATERIALS. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Using the fracture mechanics approach, the effect of an environment of high temperature primary reactor grade water on the fatigue crack growth characteristics of A533, grade B, class 1 steel plate (HSST Plate 02) and weldments is being studied. The crack growth rate da/dN is being measured as a function of ΔK_I, the change in the stress intensity factor at the tip of the crack. The 2T WOL (Wedge Opening Loading) specimen is being utilized to measure the fatigue crack growth at 550°F in an environment (excluding irradiation) typical of Pressurized Water Reactors and Boiling Water Reactors. Cycling rates are being varied from 60 to 600 cycles per minute for a minimum of 100,000 cycles. Tests are being performed on A533, grade B, class 1 steel (HSST Plate 02) and weld metal prepared by the submerged-arc, electroslag, and manual-arc processes. Material from the HAZ (heat affected zone) of the weldments prepared by the submerged arc and manual arc processes is also being studied. The test data indicate that there is little if any influence of an environment of high temperature primary reactor coolant water on the fatigue crack growth characteristics of the materials being studied. Crack growth rate data (da/dN versus ΔK_I) will be presented for the materials studied for both an environment of primary coolant water and that of air. (auth)

3897 (CONF-710342-, pp vp Paper 3) RELATIONSHIP BETWEEN MATERIAL FRACTURE TOUGHNESS USING FRACTURE MECHANICS AND TRANSITION TEMPERATURE TESTS. Sailors, R. H.; Corten, H. T. (Univ. of Illinois, Urbana). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Results of a study on steels are presented in which relations between toughness as measured by the Charpy V notch test and fracture toughness as measured by fracture mechanics test are evaluated. It was found that existing data are insufficient to establish a relationship between Charpy V (C_v) notch data and the fracture mechanics toughness parameter, K_{Ic}, that allows an adequate quantitative evaluation of critical flaw size and structural integrity of nuclear pressure vessels based on C_v data. This is true for both upper temperature shelf behavior and low and transition temperature behavior for unirradiated and irradiated materials. The most serious lack of data exists for unirradiated upper temperature shelf behavior and for irradiated materials. On the upper temperature shelf, measured fracture toughness data (K_{Ic}) is nonexistent for pressure vessel steels and must be established. In the low and transition temperature range, existing data suggest that correlations are improved most when the rate of loading in the fracture toughness (K_{Ic}) test and the C_v test are made similar. It is anticipated, but the evidence (data) is sparse, that the correlation between dynamic fracture toughness (K_{Id}) and C_v would be improved by employing a sharp crack (or equivalent) in the C_v specimen and detecting the onset of rapid crack extension in the C_v test by appropriately instrumenting the C_v test. As an interim measure, it is recommended that conservative methods of estimating K_{Ic} or K_{Id} be employed. For the upper temperature shelf behavior, the Rolfe-Novak relation is recommended. For low and transition temperature behavior, it is recommended that K_{Id} (dynamic) be measured for unirradiated material. For irradiated material, the curve for unirradiated material should be shifted along the temperature axis by an increment, ΔT, equal to the shift of the Charpy curve. (auth)

3898 (CONF-710342-, pp vp Paper 7) FRACTURE TOUGHNESS TESTS ON FORGINGS FROM 22 NiMoCr 37. Klausnitzer, E. (Siemens AG, Erlangen, Ger.). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

As part of a research project sponsored by the Government of the German Federal Republic a program has been carried out to investigate the mechanical properties of the steel 22 NiMoCr 37 (similar to ASTM A 508, class 2). The steel is widely used in the form of forgings with a wall thickness between 100 and 1000 mm for pressure vessels and other primary components of nuclear reactors, i.e., steam generators. The program mainly includes fracture toughness (K_{Ic}) measurements, crack growth measurements, drop-weight tests, impact tests, and tension tests at different temperatures. The material tested came from three different forgings with a wall thickness of 915 mm, 700 mm, and 220 mm. The chemical composition, processing, and heat treatment corresponded to the specification for original forgings. The findings of these studies are reported. The mechanical properties depend on the position within the forgings and their wall thicknesses. The results of the K_{Ic} measurements had to be compared as reference with the results of the HSST program on the 12-in. plate No. 2 (A 533, grade B, class 1). The K_{Ic} values of the forgings with the wall thickness of 220 mm and 700 mm are generally higher than the values of the reference material. The fracture toughness K_{Ic} of the plate 915 mm is much lower than above. Account should be taken of the fact that this plate was a rejected one. Hence the measured values cannot be considered representative. They may, however, possibly indicate a lower limit of the steel 22 NiMoCr 37 for such dimensions. (auth)

3899 (CONF-710342-, pp vp Paper 8) DYNAMIC FRACTURE TOUGHNESS PROPERTIES OF HEAVY SECTION A533 GRADE B CLASS 1 STEEL PLATE. Shabbits, W. O. (Westinghouse Electric Corp., Pittsburgh). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The dynamic toughness properties (K_{Id}) of ASTM A 533, grade B, class 1 steel were determined for temperatures up to 125°F. Experimental and interpretation procedures were modeled after currently recommended ASTM static practice except that the loading rates to fracture approached 1 millisecond. Compact tension specimens up to 8 in. thick were used, and the fracture characteristics were studied at constant temperature for varying loading rates and between −150 and 150°F at high loading rates. Results for different thickness specimens indicate consistent toughness properties with temperature dependence characteristics similar to the previously determined static K_{Ic} behavior but translated to a higher temperature. Results obtained varying the load rate at a given temperature indicate a gradually decreasing toughness between loading rates ($\dot{K}$) of 2.5 and 10^5 ksi $\sqrt{\text{in.}}/\text{s}$. Details of the fixturing, instrumentation, and experimental techniques developed to test 8-in.-thick compact tension specimens are discussed. Also, evidence is presented to use $\beta_c = 1$ as a criterion for dynamic plane strain behavior for A 533-B material provided that ASTM recommended practice is followed, and static yield strength is used. (auth)

3900 (CONF-710342-, pp vp Paper 9) STRAIN RATE AND CRACK ARREST STUDIES. Ripling, E. J.; Crosley, P. B. (Materials Research Lab., Glenwood, IL). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Crack initiation and crack arrest toughness values of A 533 grade B class 1 steel (HSST plate 02) have been measured with contoured double cantilever beam (DCB) specimens. As reported previously, crack arrest toughness, K_{Ia}, was insensitive to the value K_c (fracture toughness), at which fracture was initiated from the pre-existing fatigue crack. Also, the difference between initiation toughness and arrest toughness was greater at higher temperatures. Recent work has been concentrated on the measuring of crack arrest toughness at room temperature and above. By artificially reducing the crack initiation toughness it is possible to measure crack arrest toughness at temperatures where the initiation toughness could not normally be measured. One technique for reducing the initiation toughness was to impose a temperature gradient along the DCB specimen so as to initiate fracture at a low temperature and arrest the crack at a higher one. Another technique, which could be used along with the first, consisted of austenitizing the front end of the specimen with the back end immersed in water, then water quenching. When the specimen was tested, the crack would jump from the heat treated region into the base plate. So far, these techniques have made it possible to measure crack arrest toughness up to 120°F. The K_{Ia} values for temperatures between 100 and 120°F were in the range of 90 to 120 ksi-$\sqrt{\text{in.}}$ The low values correspond to cases where the crack was flat and located in the minimum section defined by the face grooves; the higher numbers were associated with cracks which departed from the minimum section. Hence, the lower values are thought to be the more significant. (auth)

3901 (CONF-710342-, pp vp Paper 10) EFFECTS OF CRACK SIZE ON THE GROSS STRAIN CRACK TOLERANCE OF A533B STEEL. Randall, P. N. (TRW Systems, Redondo Beach, CA). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Gross strain crack tolerance is a measure of fracture toughness that is useful where yielding precedes fracture yet flaw size must be treated quantitatively. In these tests, rectangular bars containing surface fatigue cracks were pulled in tension at several temperatures. Strains were measured at the edges of the specimen on a gage length spanning the plane of the crack, and also in the gross section above and below the crack. Gross strain crack tolerance is the strain at maximum load on the gage length designated. It is a function of crack size, constraint, and temperature, and perhaps other variables. In A533-B steel, the plots of all of the displacement measurements versus temperature showed a sharply defined transition temperature. Therefore, the effects of crack size in terms of temperature at which strain in the net section reached 1.5 percent, or the temperature at which gross section yielding occurred are reported. The two were essentially the same. Tests of three sizes of surface cracks in geometrically similar specimens have shown that increasing the crack size causes significantly higher temperatures to be required to reach the above criteria for gross strain crack tolerance. (auth)

3902 (CONF-710342-, pp vp Paper 11) THREE-DIMENSIONAL ELASTIC–PLASTIC STRESS ANALYSIS FOR FRACTURE MECHANICS. Levy, N. J.; Marcal, P. V. (Brown Univ., Providence). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Work on improving the efficiency of the three-dimensional finite element computer program has been completed. New features designed to minimize the number of input/output (I/O) calls are added. A direct method of solution has been incorporated in the program, and this method may be combined with an iterative scheme of solution. Thus, the iterative scheme may be used to solve the stiffness equations in the plastic range, or, to follow the direct method of solution to improve the accuracy of the results. No further development of the computer program is necessary in order to cope with large scale problems of up to 10,000 degrees of freedom. The program is used to compute the stress and strains distribution in a specimen with a semi-elliptic crack with 4500 degrees of freedom. The results are shown for a specimen made of an idealized elastic-perfectly-plastic material, and for a specimen made of the strain-hardening material used in the tests conducted by Southwest Research Institute. (auth)

3903 (CONF-710342-, pp vp Paper 12) EQUIVALENT ENERGY METHOD FOR CALCULATING ELASTIC–PLASTIC FRACTURE. Witt, F. J. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The equivalent energy method is set forth for relating flaw size, stress (that is, maximum load to fracture), and temperature for frangible, transitional, and tough behavior of materials. The basic method depends on testing a flawed model of the structure of interest at the temperature of interest and knowing the volumetric energy ratio between model and prototype. The usefulness of the method depends substantially on the generalizations that can be made from volumetric energy ratio curves. Using the equivalent energy method as a means of comparing results from a number of fracture toughness investigations on ASTM A 533, grade B, class 1 steel has led to the hypothesis that "the volumetric energy ratio for ASTM A 533, grade B, class 1 steel is dependent primarily on thickness and temperature with little or no dependence on geometry or method of loading." A correlation of data from compact tension tests, dynamic tear tests, flawed tensile specimen tests, and gross strain tests partially substantiates this hypothesis. However, the correctness of the hypothesis and the applicability of the equivalent energy method must await evaluations from additional investigations. An elastic-plastic fracture mechanics procedure is set forth of which linear elastic fracture mechanics is a special case. Based on the above hypothesis, a new fracture toughness parameter, K_{Ied}, is introduced which is a property of the material in a particular thickness. K_{Ied} is easily obtained at any temperature. Examples of the application of this method to the A 533 steel are presented. Current research results will establish the feasibility and general applicability of the method. (auth)

3904 (CONF-710342-, pp vp Paper 13) PROCEDURE FOR DETERMINING BOUNDING VALUES ON FRACTURE TOUGHNESS K_{Ic} AT ANY TEMPERATURE. Witt, F. J. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

With the increasing need to insure quantitative margins of safety in structures which potentially might contain flaws it is becoming necessary to demonstrate more than just that fracture toughness K_{Ic} is high or unobtainable because of insufficient thickness of the particular product form of interest. This problem comes particularly to the fore when attempting to determine K_{Ic} for irradiated water reactor pressure vessel steels such as ASTM A 533, grade B, class 1 plate steel. Here the problems of reactor space, fluence gradients, gamma heating, and economics for large fracture toughness specimens (say 4 to 6 in. thick) tend to limit both the number of such specimens which can be irradiated as well as confound the final results. A method is proposed for determining upper and lower bounds on the fracture toughness of a material at any temperature of interest. Supporting technical arguments and an example are presented referenced to results obtained on the ASTM A 533, grade B, class 1 steel. Since research is currently in progress which should add further confidence and validity to the method, the approach outlined should be considered as tentative and subject to additional verification. (auth)

3905 (CONF-710342-, pp vp Paper 19) ANALYTICAL BASIS FOR NOTCH SHARPENING BY FATIGUE. Merkle, J. G. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

An important problem in the design of large fracture test specimens is the development of a practical and reliable method for sharpening the machined notches that are used to cause fracture. While gross load cycling does not appear to be a feasible method for notch sharpening by fatigue for large specimens, local load cycling does appear to be a feasible method. Local compressive stresses, applied to the notch faces only, for example by hydraulic pressure, can produce the same crack tip stress intensity factor that would be produced by an overall tensile stress of the same magnitude. Calculations are made to estimate the number of load cycles required to initiate flaw growth by fatigue, at the base of a machined notch, and the number of load cycles required to grow the flaw a given distance by fatigue. Experimental data have been obtained, which tend to verify the analysis and to support the feasibility of notch sharpening by fatigue, using locally applied loads. (auth)

3906 (CONF-710342-, pp vp Paper 20) TECHNIQUE FOR GENERATING SHARP CRACKS IN LOW-ALLOY HIGH-STRENGTH STEELS. Canonico, D. A.; Hudson, J. D. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The principle for underbead cracking in ferritic materials was applied to the formation of sharp flaws. This has been done by hydrogen charging an electron-beam weld. The combination of residual stresses, optimum microstructure, and hydrogen results in a sharp "fatigue-like" crack that terminates at the unaffected base metal at the base of the weld. (auth)

3907 (CONF-710342-, pp vp Paper 21) CRACK SHARPENING BY LOCAL FATIGUE. Derby, R. W.; Klindt, K. K.; Abbatiello, A. A.; Merkle, J. G. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The machined flaws in six 6-in.-thick tensile specimens were sharpened using the principle of local fatigue as described by Clark and Ceschini in Experimental Mechanics (March 1969). The pressure and approximate number of cycles necessary for the appropriate amount of crack growth were selected by use of a semi-empirical method to estimate both the cycles to initiation and the cycles needed for growth. The design of the clamping apparatus and the problems of sealing will be discussed. Ultrasonic devices were used to monitor the crack growth for four of the six specimens. Some of the problems encountered are described. Preliminary ideas for application of the procedure to 6-in.-thick pressure vessels are presented. (auth)

3908 (CONF-710342-, pp vp Paper 22) TESTING THE SIX-INCH-THICK FLAWED TENSILE SPECIMENS. Grigory, S. C. (Southwest Research Inst., San Antonio). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Ten of the large tensile specimens have been tested. Seven of the specimens were longitudinal and three were transverse. Each specimen contained a machined notch and eight of the notches were sharpened with a fatigue crack. Test temperatures have varied from 50 to 220°F and ultimate loads have ranged from 4.7 to 7.5 million pounds. Specimen preparation and notch sharpening techniques, method of testing, and instrumentation employed are reviewed. The results of the tests are presented with discussion of typical stress distribution, temperature effects, and unexpected material behavior. (auth)

3909 (CONF-710342-, pp vp Paper 23) ACOUSTIC EMISSION MONITORING OF THE 6-INCH-THICK FLAWED TENSILE SPECIMENS. Ying, S. P. (Southwest Research Inst., San Antonio). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Acoustic emissions due to crack growth were monitored on four of the 6-in. flawed tensile specimens. Emissions in the 200 kHz range were monitored with an on-line data process system and recorded for permanent record on a wideband magnetic tape recorder. The experimental results of accumulative counts (N) fit the equation $N = AK^n$ where K is the stress intensity factor and A and n are constants. Also, the number of counts and the amplitude of each acoustic emission pulse are presented as a function of load. (auth)

3910 (CONF-710342-, pp vp Paper 24) PREDICTION OF THE FRACTURE BEHAVIOR OF THE LARGE TENSILE TESTS USING THE EQUIVALENT ENERGY METHOD. Witt, F. J. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The equivalent energy method has been proposed as a procedure for relating flaw size, stress, and temperature for ASTM A 533, grade B, class 1 steel. The initial application of the method has been applied to the 6-in.-thick flawed tensile specimen behavior being investigated. Prior to each test a calculation on the fracture behavior of the specimen has been performed. The data from compact tension specimens have been used as a basis for prediction. Since results from 6-in.-thick compact tension specimens were available only up to 75°F, reasonable extrapolations were necessary to perform the analyses. The predicted results are compared with the experimental results. Considering the extrapolation necessary to make the predictions, it is shown that the comparison generally supports the potential of the method for making quantitative fracture analyses. (auth)

3911 (CONF-710342-, pp vp Paper 25) PRELIMINARY RESULTS OF STEEL MODEL TESTS. Derby, R. W. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

A number of 3-in.-dia model pressure vessels were fabricated from HSST plate 01. The vessels were cut so that the vessel axis was perpendicular to the plane of the plate. This orientation was used to insure that laminations in the plate would not be perpendicular to the hoop direction in the vessels. Also the center material of the plate is placed along the equator of the vessel. The vessels had sharp cracks obtained by a hydrogen charging brittle weld technique. A clearly defined change in the mode of failure occurred between −1 and +26°F. For the lower temperatures the fracture was flat and complete. For the higher temperatures the failure under hydraulic loading was by leakage. Pneumatic loading was found to have no effect on the burst pressure but did affect the size of the final opening. For these badly flawed vessels operating at low temperatures the safety factor between burst pressures and code pressures was greater than three. (auth)

3912 (CONF-710342-, pp vp Paper 26) NONDESTRUCTIVE TESTING TECHNIQUES APPLIED TO IN-SERVICE INSPECTION. Reinhart, E. R. (Southwest Research Inst., San Antonio). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

A compilation is presented of work performed by various laboratories under the Edison Electric Institute (EEI) and Tennessee Valley Authority Research Program RP 79, "Inservice Inspection Program for Nuclear Reactor Vessels," and in general represents the work completed from March 1, 1970, to January 1, 1971. This program is building upon basic nondestructive testing techniques developed by the Atomic Energy Commission (AEC) and others, in order to adapt this technology to the specific needs of monitoring the integrity of pressure boundaries of operating nuclear steam generating units. The various work phases are being carried out at a number of organizations and the overall program is being managed by Southwest Research Institute (SwRI). There are presently seven active work phases on the overall program. The major technical progress of the following three work phases is reported in this paper: Project II—Development of a Nondestructive Test Method Evaluation Facility; Project V—Improvement in Reliability and Reproducibility of Conventional Ultrasonic Systems for Reactor Inspection; and Project VIII—Information Collection, Reporting, and Dissemination. (auth)

3913 (CONF-710342-, pp vp Paper 28) IN-SERVICE ACOUSTIC EMISSION MONITORING OF REACTOR PRESSURE VESSELS. Vetrano, J. B.; Jolly, W. D. (Battelle Pacific Northwest Labs., Richland, WA). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Under the sponsorship of the EEI RP 79 Research Program, Battelle Northwest is currently developing engineering models of the critical components needed for an acoustic emission system capable of inservice monitoring of nuclear reactor pressure vessels. The basic technology of this nondestructive evaluation method is based on detection of the ultrasonic wave front emanating from the tip of a growing flaw. This application imposes several unique, severe, and complicating boundary conditions on the acoustic emission system. In an operating nuclear reactor there are constant hydraulic flow noises whose amplitude at the lower end of the frequency spectrum is many times greater than that of typical acoustic emission signals. Furthermore, the acoustic emission signals to be processed are expected to occur infrequently. Various approaches to the solution of this complex signal-to-noise problem are discussed. Preliminary results of in-plant noise monitoring are also presented. Another critical area being investigated is the type of acoustic emission sensor that will be coupled to the reactor wall. This sensor must be able to resist the hostile environment of the reactor and still function over extended periods of time. Two approaches to this problem are to use a higher temperature transducing technique or to locate the sensor out of the hostile environment and sonically couple it to the vessel with a wave guide. Both of these approaches are being evaluated, and the highlights of this study are presented. The third area discussed is the determining of the source location of the acoustic emission signals. Basically, this problem is one of combining the data of transducer spacing (relative to an imaginary coordinate or grid system), sonic velocity in the pressure vessel wall (accounting for propagation mode), and relative time of arrival of signals in the sensor array to make a seismic-like computation of the origin of the source relative to the imaginary grid system. Many variations of transducer array patterns were evaluated and the one having the optimum benefits for this particular application is described. (auth)

3914 (CONF-710342-, pp vp Paper 29) EFFECTS OF WARM OVERSTRESSING ON PRESSURE VESSEL STEEL PROPERTIES. Succop, L. N.; Pense, A. W.; Stout, R. D. (Lehigh Univ., Bethlehem, PA). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The beneficial effects of warm prestressing have been demonstrated in a number of laboratory tests and should have considerable value in enhancing the fracture capability of pressure vessels. However, there is some indication that the beneficial effects may be lost under vessel operational conditions. During the warm prestressing (overstressing) process, plastic strains occur at regions in the vessel where high stress concentrations exist. When the material is subsequently exposed to elevated operating temperature, these regions become embrittled by the process of strain aging. Hence, an investigation was undertaken to study the effects of strain aging arising from overstressing on the toughness of A533B and A516 grade 70. The results of the Charpy impact and tension tests indicated that strain aging embrittlement occurs in A516 grade 70 steel and A533B steel but is more severe for the A516 grade 70 than for the A533B. Aging temperature studies proved that 400°F had lesser effect on the A516 grade 70 steel than did 500 and 650°F. For the A533B steel aging at 400°F pro-

duced negligible response, while 500 and 650°F aging produced more embrittlement. The stress relief treatment for both steels improved the Charpy impact properties. The fracture toughness data for uniformly prestrained steels showed a moderate decreasing trend in fracture toughness (K_{Ic}) for specimens that had been strained and aged. Specimens strained at a fatigue cracked notch were increased in toughness by the strain, but the benefits of this prestressing were degraded by subsequent aging treatments. Results of both uniform and notch prestrain studies indicated that stress relief treatments, following straining and/or straining and aging treatments, did not increase the K_{Ic} for the steels. (auth)

3915 (CONF-710342-, pp vp Paper 30) INDUSTRY COOPERATIVE PROGRAM ON MATERIALS PROPERTIES. Fogleman, E. L. (Lukens Steel Co., Coatesville, PA). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The Industry Cooperative Program on Materials Properties involves a detailed evaluation of the strength, toughness, and chemical and metallurgical properties of a large number of full section test samples obtained from plates, forgings, and weldments used in the fabrication of nuclear reactor pressure vessels. An up-to-date status of the results obtained in this work is described. (auth)

3916 (CONF-740606-5) EXPERIMENTAL STUDY OF THE STRESS-STRAIN PROPERTIES OF LEAD UNDER SPECIFIED IMPACT CONDITIONS. Evans, J. H.; Speckhart, F. H. (Oak Ridge National Lab., Tenn. (USA); Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering). [nd]. 26p. Dep. NTIS $4.50.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

A study was conducted to determine the dynamics stress-strain properties of lead subjected to gross compressive strains at strain rates comparable to those experienced by lead shielding in shipping containers for radioactive materials under accident conditions. Lead specimens were placed on a load cell and impacted with a free falling weight. It was found that chemical lead is not significantly strain-rate sensitive in the strain-rate range of 100–800 in/in/sec for strains up to 0.5 in/in. When the dynamic stress-strain properties are compared with static and quasi-static properties, the lead exhibits a significant degree of rate sensitivity. (auth)

3917 (CONF-740606-10) ELEVATED-TEMPERATURE TENSILE STRENGTH AND MICROSTRUCTURE OF A WELD-OVERLAID TYPE 304 STAINLESS STEEL FORGING. Klueh, R. L.; Canonico, D. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 40p. Dep. NTIS $5.00.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

The elevated-temperature tensile properties and microstructure of a type 304 stainless steel forging that was overlaid with type 308 stainless steel was evaluated. Though no significant microstructural changes could be detected by light microscopy, results of a microhardness traverse indicated that stress developed by weld metal solidification significantly increased the hardness of the forging adjacent to the fusion line. The tensile properties of weld metal, forging unaffected by the overlay process, and forging adjacent to the weld metal/forging interface were determined as functions of temperature and strain rate on specimens of three different orientations (relative to the forging cylinder). The tensile results verified the enhanced strength of the forging in the heat-affected zone: yield and ultimate tensile strengths were slightly greater than those of the type 308 stainless steel filler metal and significantly greater than those of the unaffected forging. With the exception of the unaffected forging, orientation had little effect. For all materials, only the ultimate tensile strength was significantly affected by strain rate. (auth)

3918 (HU-TFT-74-2) MOTION OF POSITRONS IN METALS. Bergersen, B.; Pajanne, E. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Jan 1974. 40p. INIS.

The different aspects of positron annihilation in metals that involve the dynamics of positron motion before annihilation are discussed. The emphasis is on the theory, but also some experimental evidence is quoted. The topics covered are: slowing down and thermalization, effective mass, temperature dependence of positron vacancy trapping, positron channeling, and escape of low energy positrons from metal surfaces. (auth)

3919 (N-73-31493) CHARACTERIZATION OF MECHANICAL AND PHYSICAL PROPERTIES OF TD-NiCr (Ni–20Cr–2ThO_2) ALLOY SHEET. Fritz, L. J.; Koster, W. P.; Taylor, R. E. (Metcut Research Associates, Inc., Cincinnati, Ohio (USA)). 1973. 244p. (NASA-CR-121221). NTIS $14.25.

Sheets of TD–NiCr processed using techniques developed to produce uniform material were tested to supply mechanical and physical property data. Two heats each of 0.025 and 0.051 cm thick sheet were tested. Mechanical properties evaluated included tensile, modulus of elasticity, Poisson's ratio, compression, creep-rupture, creep strength, bearing strength, shear strength, sharp notch, and fatigue strength. Test temperatures covered the range from ambient to 1589°K. Physical properties were also studied as a function of temperature: thermal conductivity, linear thermal expansion, specific heat, total hemispherical emittance, thermal diffusivity, and electrical conductivity. (auth)

3920 (ORNL-TM-4468) CASE OF EMBRITTLEMENT OF SHEATHED ALUMEL THERMOELEMENTS IN LMFBR FUEL PIN SIMULATORS. McElroy, D. L.; Leslie, B. C.; Clark, D. L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 20p. AT.

Alumel thermoelements sheathed in type 304 stainless steel with MgO insulation formed part of the instrumentation of a heater and were brittle after being heat treated to 975°C in hydrogen. Metallographic examinations, radiographs, electrical resistance measurements, and chemical analyses established the probable cause for this behavior. A critical amount of cold work was produced in forming the Alumel assembly and the subsequent heat treatment resulted in very large grains that spanned the diameter of the wire. The grain boundaries, which traversed the wire, were weak, and this led to the brittleness. There is no known way to restore the ductility, since the assembly cannot be worked and reannealed without fracture. (auth)

3921 (SLA-74-5247) RESIDUAL MECHANICAL PROPERTIES OF TEXTURED AND SPALL-DAMAGED BERYLLIUM. Stevens, A. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 23p. (CONF-740412-2). Dep. NTIS $4.25.

From fifteenth structures, structural dynamics, and materials conference; Las Vegas, Nevada, USA (17 Apr 1974).

The effect of internal cracks on the mechanical properties of two widely differing textures of Be is investigated. The internal cracks were introduced into polycrystalline Be samples in the form of low-level spall damage by standard plate-impact experimental techniques. Static tests were then conducted to determine the residual bending and in-plane tensile strengths of the material over a range of damage levels. Results show that the apparent yield and ultimate strengths and the strain-to-fracture of the spall-damaged samples decreased with increasing internal damage. However, the maximum decrease was less than 10% of the virgin material properties, even in samples impacted to as high as 150% of the incipient-damage impact velocity. To assess the ability of the spall-damaged samples to transmit heat, the effective thermal conductivity through the thickness of the plate samples was measured. Results show a decrease in effective conductivity with increasing spall damage, with a reduction to approximately 60% of the virgin material conductivity at the maximum level of induced spall damage. (6 figures) (auth)

3922 (WARD-OX-3045-8) RESIDUAL STRESS MEASUREMENTS IN IRRADIATED SOLUTION-ANNEALED TYPE 304 STAINLESS STEEL TUBING. Foster, J. P.; Strain, R. V.; Wolfer, W. G. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Apr 1974. Contract AT(11-1)-3045. 25p. AT.

Immersion density and residual stress measurements were made on solution-annealed Type 304 stainless steel capsule tubing irradiated up to fluence levels of 9×10^{22} n/cm^2 (E > 0.1 MeV). The measured residual stress is dependent on the competition between differential swelling which builds up differential stresses and irradiation-induced creep which relaxes these stresses. The measurements were analyzed using a bilinear swelling equation formulated with swelling data from the same heat of material. The temperatures and fluence levels of the swelling and slit tube data were each calculated with the same computer code. At high fluence, when swelling was in the steady state region, the effective irradiation-induced creep rate increased by a factor of about three. Further analysis was made assuming that stress enhanced swelling and swelling enhanced irradiation-induced creep were the enhanced relaxation mechanisms. (auth)

3923 DISLOCATION RELAXATION IN SINGLE CRYSTALS OF MOLYBDENUM. Korenko, M. K.; Mitchell, T. E.; Gibala, R. (Case Western Reserve Univ., Cleveland). Acta Met.; 22: No. 5, 649-656(May 1974).

The characteristics of the α dislocation relaxation peak in Mo were examined in three orientations of high-purity single crystals deformed in tension at 170, 300, and 450°K. For deformation at 450°K, the α peak is absent in crystals oriented for easy glide and

deformed into stage 1 of work hardening. For crystals of the same orientation deformed into stages 2 and 3 and for crystals with [001] and [101] tensile orientations, the peak is observed superimposed on a step-like background; it grows rapidly, sharpens and moves to lower temperatures with increasing amounts of plastic deformation. Crystals with the easy glide orientation deformed at 170 and 300°K exhibit rapid work hardening and display small, broad, asymmetrical α peaks. Mild strain aging at 500°K does not greatly affect the α peak, but drastically reduces the step-like background damping. The overall response of the α peak to changes in dislocation substructure is very similar to that of the Bordoni peak in fcc metals. Three widely divergent models are considered: double kink generation on non-screw dislocations, kink diffusion on screw dislocations, and breakaway of dislocations from immobile pinning points. It is concluded that the major features of both peaks are better explained by the breakaway models. For the α peak, a variation of the Hasignti trapped kink model seems most appropriate. (7 figures, 33 references) (auth)

3924 DE HAAS-VAN ALPHEN EFFECT IN GADOLINIUM. Young, R.C. (Department of Physics, University of Birmingham, Birmingham B15 2TT, England); Jordan, R.G.; Jones, D.W. Phys. Rev. Lett. 31: No. 24, 1473-1476 (10 Dec 1973).

We have measured the de Haas-van Alphen effect in a single crystal of Gd, refined by solid-state electrolysis, observing four frequencies (in the range 10^5–3×10^7 G) near the c axis and three frequencies in the basal plane. The faster oscillations identify with orbits on the third-zone sub-band Fermi surfaces of the relativistic augmented plane-wave calculations, if the sub-band energies are displaced by ±0.57 eV by the ferromagnetic internal field. (auth)

3925 THREE-BODY FORCES IN THE LATTICE DYNAMICS OF BERYLLIUM. Bertoni, C.M.; Bortolani, V.; Calandra, C.; Nizzoli, F. (Istituto di Fisica and Gruppo Nazionale Struttura della Materia, Università di Modena, Modena, Italy). Phys. Rev. Lett. 31: No. 24, 1466-1469 (10 Dec 1973).

We present a first-principles calculation of the lattice dynamics of Be. The dynamical matrix is set up by evaluating the total electron energy up to third order in the electron-ion pseudopotential. In this way we are able to describe the three-body forces, which are essential for reproducing the experimental data. (auth)

3926 INTERACTION BETWEEN MAGNONS AND MAGNETIC EXCITONS IN $TbAl_2$. Purwins, H.; Houmann, J.G.; Bak, P. (Danish Atomic Energy Commission Research Establishment Risø, Roskilde, Denmark); Walker, E. Phys. Rev. Lett. 31: No. 27, 1585-1587 (31 Dec 1973).

Inelastic neutron-scattering measurements of acoustic magnons are reported for ferromagnetic $TbAl_2$ between 4.2 and 80 K for wave-vector transfers of 0.00 and 0.10 $Å^{-1}$. Above 35 K we observe a double-peak structure in the scattered neutron intensity which is theoretically interpreted in terms of an interaction between the magnon and a magnetic exciton excited from an almost unpopulated state. This is the first observation of an interaction of this kind. (auth)

3927 FRETTING-FATIGUE DAMAGE THRESHOLD CONCEPT. Hoeppner, D. W.; Goss, G. L. (Lockheed-California Co., Burbank). Wear; 27: 61-70(Jan 1974).

Fretting fatigue studies were conducted on Ti-6Al-4V and 7075-T6 aluminum specimens cycled in axial fatigue loading at a fatigue ratio (R) of +0.1. Axial fatigue loading was applied at a frequency of 30 Hz in a laboratory environment with the fretting applied to the specimen central section through a fretting pad made of the same material as the fatigue specimen. Tests were conducted at various maximum axial fatigue loads and normal pressures. The fretting damage that occurred resulted in a significant reduction in fatigue life. It is shown that the concept of fracture mechanics are related to the "initiation" of fretting damage. (IAA)

3928 DEPOLARIZATION OF NEUTRONS IN TERBIUM IN THE MAGNETIC PHASE TRANSITION REGION. Baazov, N.G.; Mandzhavidze, A.G. (Institute of Physics, Academy of Sciences of the Georgian SSR, Tbilisi). Sov. Phys.-Solid State 15: No. 6, 1295-1296 (Dec 1973).

Temperature dependence of the change in polarization of incident polarized neutrons transmitted through polycrystalline terbium is correlated to changes in thermal hysteresis which occur in magnetic phase transition regions. (AIP)

3929 INFLUENCE OF ULTRASONIC VIBRATIONS ON THE DISSIPATIVE PROPERTIES OF TWIN BOUNDARIES IN CADMIUM. Gindin, I.A.; Volchok, O.I.; Neklyudov, I.M.; Okovit, V.S. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Solid State 15: No. 6, 1286-1286 (Dec 1973).

Ultrasonic irradiation at 77°K of twinned cadmium crystals considerably altered the temperature dependence of the internal friction. This behavior was attributed to the opposing effects of formation of low-mobility defects at twin boundaries and the increased probability of annihilation reactions. (AIP)

3930 ELECTROTHERMAL TRANSPORT IN TUNGSTEN. Zakurdaev, I.V.; Tsyganov, A.D. Sov. Phys.-Solid State 15: No. 6, 1115-1116 (Dec 1973).

An investigation was made of electrotransport of matter in a tungsten single crystal at 2000-3300°K. The direction and velocity of transport were determined by the mark method. A direct current caused atoms to move toward the cathode and a temperature gradient produced motion in the direction of the cold end. Significant transport in the bulk of the crystal (atomic velocity of the order of $1\cdot10^{-5}$ cm/sec) started at temperatures $T\geq0.8T_{mp}$, where T_{mp} is the melting point. On the surface the transport started at temperatures $T\geq0.5T_{mp}$. The activation energy of the volume self-diffusion was 6.9 ± 0.6 eV. The effective charge deduced from the position of the "equilibrium zone," i.e., the surface zone free of step structure, was 0.3 ± 0.1 electron units. The directional mass transport on the surface was found to be anisotropic. (auth)

3931 MANIFESTATIONS OF FERMI SURFACE ANISOTROPY IN THE ELECTRICAL RESISTANCE OF HEAVY RARE EARTHS IN THE PARAMAGNETIC STATE. Rao, K. V.; Rapp, O.; Sundstroem, L. J. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 9: No. 2, 129-132(Feb 1974).

In the paramagnetic temperature region for the electrical resistivity, it can be shown that $Qob/Qoc = (d_{Qb}/dT)\,(d_{Qc}/dT) = Qbm,sat/Qcm.sat = \int_{E_F} dS_c/\int_{E_F} dS_b$, where the last ratio refers to projections of the Fermi surface. Upon critically examining the assumptions involved in these equalities, the ratio of the projected areas in the case of Dy is found to be 1.3, in good agreement with careful measurements along both axes cut from the same monocrystal. Previously reported anomalous values of the slope ratios are discussed. Thus for the heavy rare earths from Tb to Lu, it is concluded that it is the anisotropy of the Fermi surface alone which is responsible for the electrical resistivity anisotropy in the paramagnetic temperature region. (auth)

3932 CORROSION RESISTANT ZIRCONIUM ALLOY. Givord, J. P.; Demars, H. (to Ugine-Kuhlmann). French Patent 2,165-270. 23 Dec 1971. 5p. (In French).

A zirconium alloy containing 0.25 to 1.5% (by weight) of iron and 0.1 to 0.6% (by weight) of vanadium is described. This alloy is particularly resistant to corrosion from pressurized water at temperatures exceeding 300°C, and can be used for the structural elements of tubes employed in nuclear reactor cores. (FR)

3933 INVESTIGATION OF THE RECOVERY AND RECRYSTALLIZATION OF Ti AND Zr FROM INTERNAL FRICTION STUDIES. Petit, J.; Quintard, M.; Mazot, P.; de Fouquet, J. (Ecole National Superieure de Mecanique et d'Aerotechnique, Poitiers, France). Mem. Sci. Rev. Met.; 70: No. 10, 753-761(Oct 1973). (In French).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

Internal friction measurements were effected at different stages during the annealing of previously cold worked titanium and zirconium bars, the measurement being made at low temperatures. Comparative studies effected by microhardness, optical microscopy, and x-ray crystallography measurements demonstrate that internal friction measurements enable the recovery and recrystallization kinetics of the two metals to be accurately determined. Discussions on the internal friction mechanisms and the behavior of this property as a function of annealing are presented. (FR)

3934 LIQUID ALKALI METALS. Proceedings of the International Conference, Nottingham, England, April 4-6, 1973. London; British Nuclear Energy Society (1973). 310p.

Forty-four papers were presented, abstracts for all have been prepared. Sectional headings are as follow: basic studies; physics of liquid metals; analytical and instrumentation techniques: sodium-water reactions; carbon behavior in sodium; fission product behavior; physical processes; and corrosion and mass transfer. Discussions are included. (UK)

For abstracts of individual papers see: 2477, 2478, 2539–2541, 2591, 2634–2641, 3083, 3084, 3783, 3835–3853, and 3935–3942.

3935 STUDY BY MASS SPECTROMETRY OF THE THERMODYNAMIC PROPERTIES OF SOME SODIUM ALLOYS. Trouve, J.; Champeix, L. (Sodium Reactor Tech. Dept., Cadarache, France). pp 25-30 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The utilization of a residual gas analyzer (quadrupole) and a high-vacuum system for the determination of thermodynamic data of liquid-vapor systems, such as Na-I and Na-Cs, is reported. The apparatus and the method used (Knudsen-cell) are described,

together with experiments executed as tests with NaI, Na, and Na–5 at. % Cs alloy. (auth)

3936 PHYSICAL MEASUREMENTS ON LIQUID METALS. Mott, B. W. (Atomic Energy Research Establishment, Harwell, Eng.). pp 39-42 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The various physical property measurements that may be made on liquid metals and alloys are reviewed with specific reference to the type of information on the nature of the liquid metal state that may be obtained from them. The property measurements include diffraction of x-rays and neutrons, changes in density on melting or alloying, viscosity, surface tension, electrical resistance, thermoelectric power, magnetic susceptibility, Knight shift, and Hall coefficient. An example is given of the application of a number of techniques to a study of the form in which oxygen exists in liquid cesium. (auth)

3937 ELECTRONIC STRUCTURE OF DISSOLVED IMPURITIES IN LIQUID ALKALI METALS. Greenwood, D. A.; Ratti, V. K. (Univ. of Bristol, Eng.). pp 43-45 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

A potential model method of studying the electronic stability of negative ions in a liquid metal is described. The calculation results indicate that halide ions in a liquid alkali metal bind an additional electron more tightly than in free space, as a result of screening by conduction electrons. The method is extended to study oxygen ions, and it predicts that O^{2-} ions are stable in liquid sodium, and possibly also in liquid cesium. Calculations of the electrical resistivity of liquid cesium containing dissolved oxygen have been made, and reasonable agreement with experiment is obtained if it is assumed that the oxygen is in the form of O^{2-} ions. (auth)

3938 CORRELATION OF CARBON CONTENT IN LIQUID SODIUM AND COVER GAS OF A HIGH TEMPERATURE LOOP. Schreinlechner, I.; Weiser, O. (Oesterreichischer Verband fuer Strahlenschutz, Vienna). pp 137-142 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Analyses from a high temperature sodium loop showed that carbon is at saturation condition. Results from cover gas analyses indicated that CO_2 is absorbed by sodium and hydrocarbons saturated and unsaturated exist in excess; they seem to be dissolved in hot sodium. Carburization of steels was observed. (auth)

3939 WETTING OF SOME FERROUS MATERIALS BY SODIUM. Hodkin, E. N.; Mortimer, D. A.; Nicholas, M. (Atomic Energy Research Establishment, Harwell, Eng.). pp 167-170 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

The wetting behavior between sodium and a number of metals and alloys was evaluated using the sessile drop technique. The effects of parameters such as the oxygen content of the sodium and the surface preparation and composition of the substrates have been assessed. It has been found that the oxygen/chromium ratio of surfaces has marked effects on wetting behavior. (auth)

3940 SOME EXPERIMENTS ON THE WETTING OF STAINLESS STEEL, NICKEL, AND IRON IN LIQUID SODIUM. Longson, B.; Prescott, J. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 171-176 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Values of the receding contact angle were obtained between cold trapped sodium and 20% cold-worked stainless steel, Type 316M, over the temperature range 98 to 800°C, and on nickel and iron over the range 98 to 300°C. Although it was found that nickel and iron specimens could be readily wetted by sodium above 250°C, yielding zero contact angles, austenitic steel specimens generally did not give angles lower than 30°. It is postulated that the reason for this is that the oxide on austenitic steel is not reduced by cold-trapped sodium. (auth)

3941 SELF-WELDING OF STRUCTURAL MATERIALS IN LIQUID SODIUM. Huber, F.; Mattes, K. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 183-189 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

It is stated that metals in contact with liquid Na at elevated temperatures are susceptible to self-welding at points of contact, and this must be considered in the construction of Na-cooled reactors. To examine this, experimental work is being carried out at Karlsruhe using the sodium tank test facility. The test materials and experimental conditions are with reference to the fast Na-cooled prototype reactor SNR 300. Details are given of this experimental work. The test materials comprised two austenitic steels, one Ni-base alloy, and one ferritic steel, and the materials were paired mainly with identical materials, since it appeared that there is a strong scattering of adhesive forces for pairs consisting of different materials, due to dissimilar thermal expansion, which in the cooling process builds up shear stresses parallel to the contact surfaces, thus falsifying the measured adhesive forces. The materials were first investigated at 700°C, a contact time of 168 hours, and a contact pressure of 1100 kgf. By varying these parameters an attempt was made to evaluate their influence. The high temperature of 700°C was chosen on the assumption that at relatively short contact times such a temperature allows obtaining test results corresponding to long periods of operation under reactor conditions. Among matters investigated were the following: influence of contact area on adhesive force, on nature of the material, on contact pressure, contact time and contact temperature, and on "flushing". All the materials tested were susceptible to self-welding. (UK)

3942 FRICTION CHARACTERISTICS OF STEELS AND ALLOYS IN LIQUID SODIUM. Wild, E.; Mack, K. J. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 191-196 of Liquid Alkali Metals. London; British Nuclear Energy Society (1973).

From international conference on liquid alkali metals; Nottingham, England (4 Apr 1973).

Friction and wear between components in sliding contact in a Na-cooled reactor may give rise to serious failure. The types of friction arising in a reactor are itemized and briefly discussed, and although there are already numerous data available, it was thought necessary to carry out more extensive experiments. The experimental sodium loop system used is described in detail and the results are discussed. Materials examined included heat resistant stainless steels, Ni-base alloys, hard-facing alloys, and cemented carbides (WC-Ni). For some of the materials tested, a friction coefficient lower than the desired value of $\mu = 0.5$ was found. For Inconel 718 the value could increase up to 0.7 under certain circumstances. Cemented carbide showed the lowest friction coefficient, but had the disadvantages of being brittle and being difficultly machinable. The hard-facing alloys Stellite 6H and Colmonoy 4 showed intermediate values and an acceptable frictional behavior. The friction constant of Stellite 6H also showed a very low temperature dependence. These alloys also show no significant problems as regards workability. (UK)

3943 ASYMMETRIC CHANGE OF THE THERMOEMISSION CURRENT AND SURFACE STRUCTURE IN CRYSTALS OF REFRACTORY METALS DURING ORIENTED TRANSFER PROCESSES. Zakurdaev, I. V.; Chernyak, E. Ya.; Shuppe, G. N.; Yakovlev, V. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2547-2552(Dec 1973). (In Russian).

Asymmetric changes in the surface state and the thermoemission properties during transfer processes can be explained by the anisotropy of the total forces acting on the crystal. Formulas are derived for each of these forces and illustrated on examples of W and Mo. The change of the thermoemission current of Mo is determined as a function of the angle between the crystal axis and the [110] plane. The change of the asymmetric components of the thermoemission currents in W and Mo is measured as a function of the amount of Th deposited on one facet of the crystal and as functions of the size of the energy field within the sample and the temperature. (JSR)

3944 INELASTIC REFLECTION OF ELECTRONS AND SECONDARY ELECTRON EMISSION OF OXIDIZED LAYERS OF Li–Mg AND Al–Li–Mg. Bronshtein, I. M.; Kudryash, A. P.; Brozdnichenko, A. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2488-2491(Dec 1973). (In Russian).

It is shown that activation of Li–Mg layers at 20 to 900°C leads to abnormally large values of coefficient of secondary electron emission (σ_t = 35 to 37 at E_{rt} = 1.5 keV). (tr-auth)

3945 VARIATIONS IN YOUNG'S MODULUS OF Fe–Cr, Fe–Mo, AND Fe–W ALLOYS. Drapkin, B. M. (Rybinsk Technological Inst., USSR). Strength Mater. (USSR) (Engl. Transl.); 5: No. 4, 475-476(Apr 1973).

Translated from Prob. Prochnosti; 5: No. 4, 78-79(Apr 1973).

The effects of alloy composition on Young's modulus were studied. The resulting data confirm the hypothesis that the complex nature of the change in the elastic properties of iron alloys

is explained by the competition between the dimensional factor and the chemical reaction of the elements arising from the special features of their electronic configuration. Chromium, which has a rather larger atomic diameter than α-iron (2.54 and 2.42 Å respectively), increases the crystal lattice parameter, which usually leads to a weakening of bonds. However, since the effect of this factor is small the reduction in the modulus takes place at appreciable chromium concentrations and with a further increase in chromium content the modulus increases rapidly. An increase in temperature, which increases the interatomic distance, weakens the action of the dimensional factor, as is also indicated by the appearance of the component element concentration curves. The introduction of molybdenum does not lead to a substantial increase in the modulus, owing to the appreciable increase (compared with chromium) in the atomic diameter (2.78 Å), which levels the strengthening of the chemical interaction directly between the Mo and Fe atoms. The behavior patterns noted are also clearly exhibited in the Fe–W alloys. (auth)

3946 HIGH PRESSURE BEHAVIOUR OF LIQUID CESIUM. Ramesh, T. G. (National Aeronautical Lab., Bangalore, India). Pramana; 1: No. 1, 21-30(Jul 1973).

The anomalous behavior of liquid cesium at high pressures is discussed. A model for the phenomenon of electron collapse in the liquid phase, based on the anomalous density variation of liquid cesium with pressure, is proposed. The process of 6s → 5d electron collapse is pictured as the formation of a virtual bound state and the tunneling process accounts for the 6s ≈ 5d dynamic conversion. The same model, together with the Friedel sum rule, is used to explain the resistivity variation of liquid cesium with pressure. The resistivity minimum observed in most of the liquid alkali metals in the low pressure region has been explained. The agreement with the experimental curve is good in the low pressure region whereas a large discrepancy exists at higher pressures. This may be due to the breakdown of the Ziman's resistivity formula under conditions of resonance scattering. (auth)

3947 THERMODYNAMIC FUNCTIONS OF HYDRATION AND OXIDOREDUCTION OF LANTHANIDE M^{3+} IONS. Guillaumont, R.; David, F. (Univ. Paris-Sud, Orsay, France). Radiochem. Radioanal. Lett.; 17: No. 1, 25-39(10 Apr 1974). (In French).

Recent thermodynamic data on lanthanides, (metal, atom, and aqueous trivalent ions) is surveyed for selection of the best experimental values. Variation of free enthalpy of hydration versus Z shows a "tetrad effect"; the same for $E^{\circ}_{M^{3+}/M_2}$ shows two discontinuities on europium and ytterbium. (auth)

3948 MECHANICAL PROPERTIES OF CLADDING MATERIALS AFTER ANNEALING WITH CARBIDE FUELS. Goetzmann, O.; Hofmann, P.; Sarikaya, Y. (Kernforschungszentrum, Karlsruhe, Ger.). pp 396-399 of Reactor Meeting. Section 2. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). (In German).

3949 MAGNETIC ENTROPY OF $ZrZn_2$. Viswanathan, R. (Univ. of California, San Diego, La Jolla). J. Phys., F (London); 4: No. 3, L57-L58(Mar 1974).

The magnetic entropy of $ZrZn_2$ is evaluated by comparing its low temperature heat capacity data with that of nonmagnetic $ZrCu_{1.1}Al_{0.9}$. It is found to be finite but small, indicating that $ZrZn_2$ is very much an itinerant electron ferromagnet. (auth)

3950 PHONON DISPERSION RELATION OF SCANDIUM. Maurya, J. R.; Srivastava, R. S.; Kushwaha, S. S. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 11: No. 8, 632-633 (Aug 1973).

Phonon dispersion relation for scandium has been theoretically studied, using the non-central force model. Volume forces have been incorporated phenomenologically. Dispersion curves obtained for the symmetry directions have been compared with the neutron scattering results. The theoretical results are found to be in good agreement with those from experiments along all the branches of symmetry directions except the $TO_{||}$ branch of Σ direction. (auth)

3951 MECHANICAL TESTS OF METALS SUBJECTED TO HYDROSTATIC PRESSURES UP TO 15kbar. Carpentier, D.; Francois, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 23-40 of Deformation and the Rupture of Solids Subjected to Multiaxial Stresses. Vol. II. Paris; Editions Essor (1973). (In French).

From international colloquium on the deformation and the rupture of solids subjected to multiaxial stresses; Cannes, France (4 Oct 1972).

Tests (principally tensile and compression) were carried out on samples contained in a vessel filled with gas at pressures up to 15 kbar. The stress measurements were carried out using a dynamometer enclosed in the high pressure vessel. The stress-strain curves were recorded during the tests. The crosshead speed could be varied between 0.1 and 10 mm/minute. Most of the results obtained concern hexagonal metals: beryllium, zinc, and cobalt. In general, no large changes in the strain hardening curves were observed other than the typical increase in ductility. Tests were then performed on single crystals of beryllium and cobalt in order to determine the effect of pressure on the critical resolved shear stresses in the various slip planes. Some minor modifications were observed in comparison with the behavior at atmospheric pressure; they do not, however, account for the large increase in ductility. In consequence, particular attention was given to studying the fracture of metals under high pressure in this vessel. In general tensile tests were used. (FR)

3952 CURRENT EVALUATION OF 2¼ CHROME 1 MOLYBDENUM STEEL IN PRESSURE VESSELS AND PIPING. Third Annual Pressure Vessels and Piping Conference, and the 27th Annual Petroleum-Mechanical Engineering Conference, New Orleans, Louisiana, September 17–21, 1972. Schaefer, A. O. (ed.). New York; American Society of Mechanical Engineers (1972). 123p. (CONF-7209113-). $9.50.

The five papers deal respectively with the high-temperature strength and ductility of quenched and tempered 2¼ Cr–1 Mo steel, fracture toughness, a program to study low-cycle fatigue and creep interaction in steels at high temperatures, apparatus and techniques for low-cycle fatigue with interspersed creep testing, and tests and evaluation at high temperatures. (auth)

3953 NEUTRON DIFFRACTION STUDY OF SINGLE CRYSTAL HOLMIUM TO 0.4°K. Little, G. R. Columbus, OH; Ohio State Univ. (1973). 207p. University Microfilms Order No. 74-3234.

Thesis (Ph. D.).

Neutron diffraction measurements with unpolarized neutrons have been made on a single crystal of Ho in the temperature range 4.2 to 0.4°K with the aim of studying the change in coherent scattering produced by the hfs induced polarization of the Ho nuclear spins. It was found that the magnetic satellite reflections decrease linearly with nuclear polarization, but that no effect could be seen on the ordinary hexagonal reflections. The incoherent scattering amplitude was found to be $b_{inc} = +0.086 \pm 0.008 \times 10^{-12}$ cm. The magnetic structure reported by Koehler et al., [W. C. Koehler, J. W. Cable, M. K. Wilkinson, and E. O. Wollan, Phys. Rev. 151, 414 (1966)] was confirmed except for the spin bunching parameter δ. The value $\delta = 8.3$ was found in this investigation where Koehler finds $\delta = 5.8$. Since $\delta = 0$ represents complete bunching, the measurement found here suggests that the magnetic anisotropy does not affect the magnetic structure as much as Koehler suggests. Using the Ho coherent scattering amplitude $b_{coh} = 0.85 \times 10^{-12}$ cm it is found that the two compound nucleus scattering amplitudes are $b_+ = +1.00 \pm 0.02 \times 10^{-12}$ cm and $b_- = +0.66 \pm 0.02 \times 10^{-12}$ cm. (Diss. Abstr. Int., B)

3954 PHASE STABILITY IN ZINC AND CADMIUM RICH ALLOYS. Bienvenu, Y. C. Pittsburgh; Carnegie–Mellon Univ. (1973). 234p. University Microfilms Order No. 73-26,952.

Thesis (Ph. D.).

The problem of phase stability in zinc- or cadmium rich alloys has been studied, using the technique of rapid quenching from the melt ("splat-cooling"). Four binary systems of zinc or cadmium with copper or silver have been investigated. A detailed study of the relationship between the lattice parameters of the metastably extended hcp phases ε and η in systems Zn–Ag and Zn–Cu has shown that a discontinuous transition between these phases is found at an electron concentration of about 1.91, and at an axial ratio of about 1.61. The application of the rapid quenching technique to the Zn–Cd system has not resulted in any significant extension of the homogeneity range of the η phases. As a contrast to this behavior, a continuous series of metastable solid solutions has been produced in the pseudo-binary system $Zn_{80-x}Cd_xAg_{20}$ between the ε phases of the binary systems Zn–Ag and Cd–Ag. The results are interpreted in terms of the electronic energy of the hcp structure in zinc- or cadmium rich alloys. A view of the stability relationships of these various hcp phases is presented in which both the conduction electrons (s + p) and the d electrons play an important part. (Diss. Abstr. Int., B)

3955 ENVIRONMENTAL EFFECTS AT ELEVATED TEMPERATURE ON LOW-CYCLE FATIGUE BEHAVIOR AND ON FATIGUE-RELATED MATERIAL CHARACTERISTICS. Conway, J. B. Society of Manufacturing Engineers, Paper 1073-619. Cincinnati; Society of Manufacturing Engineers (1973). 26p. $2.00.

Recent studies of the effect of the test environment on low-cycle fatigue behavior have yielded some very important information. Not only was fatigue life found to be significantly affected by the environment but the effect of certain test parameters was found to

be different in different test atmospheres. Some of these effects are reviewed in terms of their effect on a generalized fatigue equation. Other fatigue-related phenomena are discussed to suggest how analytical approaches develop using data obtained in air may be used in eventual evaluations in other environments. Particular emphasis is given to the cyclic strain softening behavior noted in recent studies of zirconium–copper, chromium–copper and Zr–Cr–Mg copper tested in argon at 538°C. (IAA)

3956 NUCLEAR MAGNETIC RESONANCE IN THE AMORPHOUS TRANSITION METAL VZr ALLOY. Han, K. S. Williamsburg, VA; Coll. of William and Mary (1973). 72p. University Microfilms Order No. 74-2303.

Thesis (Ph. D.).

The nuclear magnetic resonance of ^{51}V in both the amorphous and crystalline phase of VZr alloy film has been investigated in an effort to determine the parameters controlling the electronic structure of the amorphous phase relative to the crystalline phase. Changes in the Knight shift, the line width, and the intensity of the absorption line of ^{51}V for both the amorphous phase and the crystalline phase have been measured at 77°K employing a static magnetic field ranging from 8 to 17 kilogauss. All observed changes in Knight shift of ^{51}V in the amorphous phase of VZr alloy film are small, and show a slight linear field dependence as compared with that in the corresponding crystalline phase. On the other hand the line width of ^{51}V in the amorphous phase is considerably larger than that in the crystalline phase and has a strong field dependence. This behavior may be accounted for in terms of Friedel oscillations or the rigid band model. The significant decrease in the line intensity of the amorphous phase relative to that of the crystalline appears to be consistent with an all or nothing wipeout model. It is concluded that the quadrupole interaction of ^{51}V with the large electric field gradient, which is produced by the lattice distortion and redistribution of the occupied electronic states, is probably associated with gas impurities trapped in the amorphous VZr film. (Diss. Abstr. Int., B)

3957 STRENGTH OF A B–Al COMPOSITE WITH BRITTLE FIBER. Mileiko, S. T.; Sorokin, N. M.; Tsirlin, A. M. (Inst. of Solid State Physics, Moscow). Mekh. Polim.; 840-846(1973). (In Russian).

A fracture model of a composite consisting of a metal matrix and brittle fibers is examined. It is shown that for small volume contents of the fibers, there occur local ruptures of the individual fibers and that the resulting fracture depends strongly on the arrangement of the fibers; samples with fibers uniformly distributed over the cross section exhibit the best strength properties. The existence of an optimal volume content of continuous brittle fiber is demonstrated. A crack created by the rupture of a fiber propagates immediately across the sample. The theoretical predictions are verified experimentally. (IAA)

3958 EFFECT OF STRESS SENSITIVITY ON STRESS-RUPTURE DUCTILITY OF ZIRCALOY-2 AND Zr–2.5 WT. % Nb. Ibrahim, E. F.; Coleman, C. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Met. Quart.; 12: No. 3, 285-287(1973).

Tables are presented of the stress–rupture properties of extruded and 19% cold drawn Zircaloy-2 and extruded and 23% cold drawn Zr–2.5 wt % Nb in the temperature range 573–723°K. The out-of-pile variation of the creep rupture ductility with the stress sensitivity of minimum creep rate for these two alloys is graphed. It is predicted that the creep ductility of in-reactor components of these alloys will be very high. (CA)

3959 EFFECTS OF IMPACT LOADING ON URANIUM AND TUNGSTEN-BASED MATERIALS. Irwin, G. J. (Defense Research Establishment, Ottawa). Can. Met. Quart.; 12: No. 3, 351-354(1973).

Specimens of U–2Mo, U–1Mo–1Nb–1Zr, and W–0.3Ni–0.7Cu were impacted against steel targets over a velocity range that would produce shock wave deformation. The uranium-based alloys have a limited work hardening capacity and a tendency toward mechanical instability. The tungsten-based alloy, by contrast, resists shear and is considerably more stable dynamically. (CA)

3960 DYNAMIC DIFFERENTIAL CALORIMETRY OF INTERMETALLIC COMPOUNDS. II. Heats of Formation, Heats and Entropies of Fusion of Rare Earths–Lead ($REPb_3$) Compounds. Palenzona, A.; Cirafici, S. (Univ., Genoa). Thermochim. Acta; 6: No. 5, 455-460(Jul 1973).

Dynamic differential calorimetry has been employed to evaluate the heats of formation, heats and entropies of fusion of $REPb_3$ compounds, where RE = La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, and Yb. The results obtained have been estimated to be correct to within ±5 to 6%. The general trend is a decrease in the heat of formation from La to Tm, which is correlated with the magnitude of the lanthanide contraction in these compounds. (INIS)

3961 FORMATION OF INDENTED (1122) TWIN INTERFACES IN ZIRCONIUM. Robin, C.; Dickson, J. I. (Ecole Polytechnique, Montreal). Can. Met. Quart.; 12: No. 3, 245-251 (1973). (In French).

A study of the formation of indented $\{11\bar{2}2\}$ twin interfaces in zirconium shows that the sides of the indentations that form at the free surface are parallel to the $\{10\bar{1}1\}$ planes containing the twinning direction; thus, the formation of indentations can be explained by a cross-slip mechanism. The conditions favoring the formation of indentations are identified as those producing a large twinning shear perpendicular to the crystal surface. The vast majority of the indentations occurred at the re-entrant corner formed between the surface of the twin and that of the matrix. These conditions are discussed in terms of the stress concentration factor resulting from the change, caused by twinning, in the geometry of the surface, the interaction between dislocations gliding on the twinning plane and obstacles in their paths and the accommodation slip occurring near the twin interfaces. (tr-auth)

3962 STANDARD GIBBS ENERGIES OF FORMATION OF UFe_2 AND UCu_5 FROM SOLID-STATE E.M.F. MEASUREMENTS. Yoshihara, K.; Kanno, M. (Tokyo Univ.). J. Inorg. Nucl. Chem.; 36: No. 2, 309-312(Feb 1974).

The standard Gibbs energies of formation of UFe_2 and UCu_5 were determined with galvanic cells using a solid calcium fluoride electrolyte. Calcium fluoride is an ionic conductor over the temperature range of the measurements. The constructions of fluorine concentration cells were as follows: $U,UF_3|CaF_2$ (single crystal)$|UF_3$, UFe_2, Fe; $U,UF_3|CaF_2$ (single crystal)$|UF_3$, UCu_5, Cu. From the e.m.f. values, the standard Gibbs energies of UFe_2 and UCu_5 were calculated as follows: $\Delta G_f^0(UFe_2) = 2.54 \times 10^{-3}\,T - 16.88$ kcal/mol (993 to 1043 K); $\Delta G_f^0(UFe_2) = 3.23 \times 10^{-3}\,T - 17.58$ kcal/mol (1043 to 1153 K); $\Delta G_f^0(UCu_5) = -2.49 \times 10^{-3}\,T - 2.47$ kcal/mol (993 to 1053 K); $= -0.74 \times 10^{-3}\,T - 4.31$ kcal/mol(1053 to 1153 K). (auth)

3963 COMPLEX BORIDES WITH PLATINUM METALS. Rogl, P. (Univ., Vienna); Nowotny, H.; Benesovsky, F. Monatsh. Chem.; 103: No. 4, 965-989(Jul 1972). (In German).

The crystal structures of $W_2Ir_3B_{8-x}$ ($x \approx 1$) and Mo_2IrB_2 have been derived by means of single crystal photographs. $Mo_{2.1}Ir_{1.1}B_5$ is isotypic with $W_2Ir_3B_{8-x}$, but displays a more statistical distribution, however, of the two kind of metal atoms. In Mo_2IrB_2 there are B_4-groups present. (Cr,Ru)B as well as (Cr,Os)B crystallize with FeB-type structure, (Mo,Ru)B with CrB-type structure and $(Mo,Ru)_3B_4$ is isotypic with Ta_3B_4. The principles of the structural chemistry of binary and ternary borides within the range of 40 to 60 at. % boron are discussed. (auth)

3964 INTERACTION OF LAVES PHASES IN SOME SYSTEMS OF THREE TRANSITION METALS. Svechnikov, V. N.; Markiv, V. Ya.; Pet'kov, V. V. pp 31-35 of Khimiya Metallicheskikh Splavov. Zhavoronkov, N. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Results of experimental investigations of the interaction of Laves phases in some systems of transition metals with Zr are reported. The systems studied are $ZrX_2'–RX_2'$ and $ZrX_2–ZrX_2'$, where R is Ti, Hf, Nb, Ta; X is V, Cr, Mo, W, Mn, Re; and X' is Fe, Co, Ni. The existence of a correlation between the types of interaction of the double Laves phases between themselves and the positions of the R, X, and X' components is shown. (6 fig) (tr-auth)

3965 MECHANICAL PROPERTIES OF SINTERED FIBER METAL COMPOSITES. Rostoker, W.; Galante, J. O.; Shen, G. (Univ. of Illinois, Chicago). J. Test. Eval.; 2: No. 2, 107-112 (Mar 1974).

Kinked, short-length, fine wire can be molded by conventional powder metallurgy procedures and sintered to a porous composite with large proportions of interconnecting voids. This material has potential applications for implanted prosthetic systems. The material, either Ti or vitallium (Co–20Cr–15W–10Ni), behaves in a nonlinear elastic fashion which may be approximated as two linear elastic processes. In the strain range of 0 to about 0.5%, the elastic modulus can be less than 1 kg/mm^2. In a higher strain regime, the elastic modulus is about 100 kg/mm^2. A total elastic strain range of 1.5 to 4% is found. (8 fig) (auth)

3966 FRACTURE TOUGHNESS STUDY OF A GRADE 300 MARAGING STEEL WELD JOINT. Blauel, J. G. (Fraunhofer Gesellschaft eV, Freiburg i. B.); Smith, H. R.; Schulze, G. Weld. J. (N. Y.); 53: No. 5, 211-s-218-s(May 1974).

The plane strain fracture toughness (K_{Ic}) of a gas tungsten-arc (GTA) welded joint prepared from 10 mm thick, grade 300, maraging steel was determined. Transverse three-point bend specimens, 10 × 10 × 55 mm, were prepared with notches and precracks preferentially located in the weld and the heat-affected zone (HAZ),

the outline of which had been revealed by prior polishing and etching. All critical K_I values less than about 270 kg mm$^{-3/2}$ satisfied ASTM validity criteria for K_{Ic}; these included determinations for all microstructures except one that was characterized by a very high stable austenite content. The effect of microstructural and property variations characteristic of the HAZ on the determination of K_{Ic} was studied using "weld simulation" specimens thermally treated in a Smit weld simulator. Results were correlated with those obtained from actual welds on the basis of equivalent microstructures, mechanical properties, and thermal treatments. From this study, a tendency towards embrittlement due to short time exposure at 750°C was detected. It was also noted that K_{Ic} appeared to be independent of grain size. Typical K_{Ic} values of the weld joint were as follows: for the base material: 250 kg mm$^{-3/2}$ for the high austenite zone: greater than 290 kg mm$^{-3/2}$ for the transformed zone: 230 kg mm$^{-3/2}$ and for the weld: 190 kg mm$^{-3/2}$. (auth)

3967 TEST PROCEDURE FOR DETERMINING THE INFLUENCE OF STRESS RATIO ON FATIGUE CRACK GROWTH. FitzGerald, J. H. (Northrop Corp., Hawthorne, CA); Wei, R. P. J. Test. Eval.; 2: No. 2, 67-70(Mar 1974).

A test procedure is outlined by which the rate of fatigue crack growth over a range of stress ratios and stress intensities can be determined expeditiously using a small number of specimens. This procedure was developed to avoid or circumvent the effects of load interactions on fatigue crack growth, and was used to develop data on a mill annealed Ti-6Al-4V alloy plate. Experimental data suggest that the rates of fatigue crack growth among the various stress ratios may be correlated in terms of an effective stress intensity range, ΔK_{eff} at given values of K_{max}. This procedure is not to be used, however, for determining the corrosion fatigue crack growth characteristics of alloys when non-steady-state effects are significant. (auth)

3968 MAGNETOCRYSTALLINE ANISOTROPY IN THE CUBIC $TbAl_2$ COMPOUND. Barbara, B. (CNRS, Grenoble, France); Rossignol, M. F.; Purwins, H. G.; Walker, E. Phys. Status Solidi (a); 22: No. 2, 553-558(16 Apr 1974).

The isothermal magnetization of a $TbAl_2$ single crystal was measured along the main symmetry directions in static magnetic fields up to 150 kOe and in the temperature range from 1.5 to 300°K. ⟨111⟩ is the easy direction of magnetization at all field strengths and for all temperatures below the Curie point T_c = 105°K. The spontaneous magnetization along ⟨111⟩ follows a Brillouin law; however, there is a strong magnetization anisotropy. By neglecting magnetostriction, the thermal variations of the anisotropy parameters of 4th and 6th order have been obtained: They are of the same type as those anticipated by Callen and Callen. (auth)

3969 LATTICE RELAXATION AT NON-CONSERVATIVE ANTIPHASE BOUNDARIES IN Ni_3Mo. van Tendeloo, G.; Amelinckx, S. (Center State Univ., Antwerp). Phys. Status Solidi (a); 22: No. 2, 621-629(16 Apr 1974).

Nonconservative antiphase boundaries in the intermetallic alloy Ni_3Mo were studied by electron microscopy. It is shown that if a small excess of molybdenum is present along the boundary, a relaxation of the lattice occurs along the interface. This gives rise to a small supplementary displacement vector e, the total displacement vector being R + e. The direction and the sense of e were determined from diffraction experiments; the supplementary displacement is equivalent to a small expansion of the boundary regions. An analysis of the structural model confirms the results. (8 fig) (auth)

3970 MOESSBAUER EFFECT MEASUREMENTS ON PdGd ALLOYS. Prowse, D. B.; Cashion, J. D. (Monash Univ., Clayton, Australia). Phys. Status Solidi (a); 22: No. 2, 631-638(16 Apr 1974).

A study was made of alloys of 1, 5, and 10% Gd in Pd, $GdPd_3$, and a source of ^{155}Eu in Pd, using the 86.5 keV transition in ^{155}Gd. The ordering temperatures of these alloys were found to be lower than the ordering temperatures determined using magnetization measurements but correlate well with the peak in heat capacity measurements. The saturation hyperfine field of the two most concentrated alloys was found to be (19 ± 2) T while the PdEu source was found to exhibit electronic relaxation effects in the range 0.4 to 0.9°K. The isomer shift measurements show that the alloys have the largest values for the electron density at the nucleus of any known trivalent gadolinium compounds. (24 references) (auth)

3971 COMPUTER SIMULATION OF MOTION OF SCREW DISLOCATION IN MODEL B.C.C. LATTICES. II. Orientation Dependence of Slip. Kuramoto, E.; Minami, F.; Takeuchi, S. (Tokyo Univ.). Phys. Status Solidi (a); 22: No. 2, 411-419(16 Apr 1974).

To understand the mechanism of the plastic anisotropy in bcc metals at low temperatures, motion of screw dislocation under stress at 0°K for various orientations was computer-simulated using model bcc lattices having systematically varied inter-atom-row potentials. Below the Peierls stress, several types of transitions of the core structure took place. As a result, dislocation motion was quite anisotropic and the orientation dependence of the Peierls stress did not obey Schmid's law. $\tau_p - \chi$ and $\psi - \chi$ relations obtained for some range of inter-atom-row potentials were in agreement with the observed results on refractory bcc metals (Nb, Mo, Ta, W, Fe) at low temperatures except the operative slip plane near χ = 30°. (10 fig) (auth)

3972 PREPARATION AND STRENGTH PROPERTIES OF A Cu-W FIBER COMPOSITE MATERIAL. Havalda, A.; Taborsky, L.; Ivan, J.; Mauer, J.; Sebo, P. (Ustav Kovovych Materialov, Bratislava). Kovove Mater.; 11: No. 6, 717-725(1973). (In Slovak).

Results of a study of the strength properties of a composite material consisting of a copper matrix and tungsten reinforcing fibers and fabricated by in-vacuum casting of the fibers are given. From a study of the effect of the mold material on the quality of the resulting composites, it is concluded that a ceramic mold is more suitable than a graphite mold in the fabrication of such composites, since a graphite mold leads not only to more significant overheating, and thus to embrittlement, of the fibers, but also to chemical interaction. (IAA)

3973 INTERPRETATION OF THE INTERNAL STRESS MEASURED BY A TRANSIENT DIP TEST IN HIGH-TEMPERATURE CREEP OF METALS. Orlova, A.; Cadek, J. (Ustav Fyzikalni Metalurgie, Brno). Z. Metallk.; 65: No. 1, 55-57 (Jan 1974).

The internal stress as measured by the strain transient dip test in high-temperature creep of pure metals is interpreted by means of the characteristics of the dislocation substructure. The interpretation is based on the assumption that the internal stress is contributed by two independent sources-dislocations in subgrains and the long-range stress fields of semi-infinite subboundaries. (GE)

3974 ENTROPY OF LIQUID METALS. Lysov, V. I.; Petrenko, P. V.; Fedorov, V. E.; Khar'kov, E. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 322-328(Feb 1974). (In Russian).

A formula is presented for estimating the entropy of liquid metals which may be represented as entropy of ideal gas minus the constant term that slightly changes in transition from metal to metal and may be estimated through the function of radial atom distribution in liquid metal. This evidences for a similarity of the liquid metals structure at the melting point. Correlation entropy was estimated by an electronic computer through the function of radial atom distribution calculated by the model of solid spheres. The computation results are in good agreement with the experimental data. Equations are suggested for calculating entropy of fusion, fusion temperature, and heat of liquid metal fusion. They are in satisfactory agreement with the experimental data. (auth)

3975 HYPERFINE FIELD MEASUREMENTS ON DILUTE SCANDIUM IN COBALT MATRIX. Singhvi, A. K.; Rao, G. N. (Indian Inst. of Tech., Kampur). Phys. Lett.; 47A: No. 4, 319-320(8 Apr 1974).

Using the time differential perturbed (γ-γ) angular correlations TDPAC technique, the hyperfine field (H_{hf}) at ^{46}Sc nuclei in cobalt matrix is measured for the first time and the value obtained is $H_{hf}ScCo$ (RT) = −58 ± 4 kOe. The measured hyperfine field value is compared with the predictions of the existing hyperfine field models. (auth)

3976 STRUCTURE, TYPE OF FRACTURE, AND DUCTILE-BRITTLE TRANSITION TEMPERATURE OF W-C ALLOYS. Pod'yachev, V. N.; Gavrilyuk, M. I.; Zhabina, V. A. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 847-850(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 10, 17-20(Oct 1973).

The effects of 0.01 to 0.2% C were studied. The fracture type changes from mixed to transcrystalline, indicating that C has a strong effect on W grain boundaries. The ductile-brittle transition temperature decreases with C to a minimum (300°C) at 0.10% C, then increases again; this can be explained by the presence of brittle eutectic inclusions. (DLC)

3977 LOW-ALLOY ELECTRON-BEAM MELTED W ALLOY. Naumkin, O. P.; Mikhailov, V. G.; Efimov, A. E.; Nemirovskaya, F. S. (All-Union Scientific-Research and Design Inst. of Refractory Metals and Hard Alloys, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 770-772(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 37-39(Sep 1973).

ZrC and Ta were added to refine the grain size of electron-beam melted W; grain refinement occurred for 0.2% ZrC and 0.2% Ta. The mechanical properties of TSV-1 alloy (0.2% ZrC, 0.2% Ta) were determined: ductile–brittle transition temperature and tensile properties. The ZrC and Ta additions also increases the recrystallization temperature. (DLC)

3978 EFFECT OF SMALL BORON ADDITIONS ON THE PROPERTIES OF Mo–0.2Zr. Klypin, B. A.; Morgunova, N. N.; Lastochkin, R. R. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 773-776(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 39-44(Sep 1973).

The properties studied were grain size, hardness, ductile–brittle transition temperature, tensile properties, electric resistivity, and microstructure. The B addition was varied from 0.001 to 0.05%. It is concluded that B inhibits the solution of C in Mo, and that the resulting clean sections free from C leads to stress relaxation and lowered ductile–brittle transition temperature. (DLC)

3979 EFFECT OF RARE-EARTH METALS ON THE STRUCTURE AND PROPERTIES OF RECRYSTALLIZED Cr. Rakitskii, A. N.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 777-780(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 44-48(Sep 1973).

Property changes were determined for recrystallized Cr alloyed with Y, La, Ce, Pr, Nd, or Gd. The additions affect the grain growth in secondary recrystallization, with the effect being a decrease at 0.4-0.7%. The additions also increase the low-temperature ductility in the recrystallized condition and increase the heat resistance; the tendency to saturation with nitrogen is decreased. (DLC)

3980 EFFECT OF DEFORMATION ON RECRYSTALLIZATION OF Ti ALLOYS. Alferova, N. S.; Shevchenko, V. I. (All-Union Scientific-Research and Construction-Technological Inst. of the Pipe Industry, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 785-789(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 52-57(Sep 1973).

The investigation was conducted on technically pure α-Ti (VT1) and unstable β-Ti alloy VT15 (3% Al, 6.5% Mo, 10.5% Cr). Results show that the cold deformation not only affects the size of recrystallized grains but also the recrystallization mechanism. A diagram of the effect is drawn; it indicates that recrystallization begins after solution of the dispersed α phase, and that the increased recrystallization temperature with deformation is due to the lower temperature at which dispersed particles dissolve. (DLC)

3981 SOLIDIFICATION OF QUATERNARY Al–Be–Mg–Zn ALLOYS. Nagorskaya, N. D.; Novoselova, A. V.; Fridlyander, I. N.; Abdullaev, G.; Gol'denberg, A. E.; Semenova, Z. G. (Moscow State Univ.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 812-814(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 72-74(Sep 1973).

The solidification of cast alloys of the Al–Be–Mg–Zn system was investigated in the region of primary solidification of (Be) phase and the precipitation of binary eutectic (Al + Be). Phase diagrams were plotted for the cut with a constant concentration of beryllium (20 wt %) and aluminum (70 wt %). Solidification begins at temperatures around 1150°C and is completed at 435-480°C, depending on the relative amounts of Mg and Zn. A broad region was found (5-8 wt % Zn) in which the cast alloys consist of three phases: (Be), (Al), and T phase of the Al–Mg–Zn system. The presence of ternary eutectic in the alloys is evidently due to insufficiently slow solidification of phases, particularly the solid solution based on Al. (auth)

3982 PROPERTIES OF WELDED JOINTS IN Ti–V, Ti–V–Al, AND Ti–Zr–Al ALLOYS WITH AN ELEVATED O CONTENT. Gurevich, S. M.; Blashchuk, V. E.; Onoprienko, L. M. (Inst. of Electric Welding, Kiev). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 10, 832-834(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 9, 6-8(Oct 1973).

Ti-2.5V, Ti-2.5V-3Al, and Ti-5Zr-2Al alloys with an elevated oxygen content and welded joints of these alloys have satisfactory mechanical properties, high corrosion resistance in hydrochloric acid solutions at concentrations up to 10%, and are not susceptible to corrosion cracking in $MgCl_2$ or chloride solutions. Due to the lack of data on long-term tests, these alloys cannot yet be recommended for welded chemical equipment. (auth)

3983 MECHANICAL PROPERTIES AND THERMAL STABILITY OF Ti–Zr–Al ALLOYS WITH AN ELEVATED O CONTENT. Peradze, T. A.; Fatkullina, L. P. (Inst. of Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 835-837(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 10, 9-10(Oct 1973).

Alloy AK3 (2.1% Al, 5.3% Zr, 0.35% O) of the optimal composition has high thermal stability and ductility. The strength at 500°C is comparable with the long-term strength of mass-produced titanium alloys. The fatigue strength of the alloy is fairly high despite the elevated oxygen content. (auth)

3984 MECHANICAL PROPERTIES OF NITRIDED NIOBIUM ALLOYS. Lakhtin, Yu. M.; Kogan, Ya. D.; Bobok, A. N.; Zakharova, G. V.; Abashin, G. (Moscow Highway Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 9-10, 842-846(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 10, 13-17(Oct 1973).

Nitriding of niobium and its alloys (VN2AE = 4.7 Mo, 0.48 Zr; VN3 = 4.65 Mo, 1.56 Zr) increases the ultimate strength by 50-100% at room temperature. Nitriding increases the heat resistance of niobium and its alloys 30-150% in short-term and long-term tests. The strengthening effect is due to coherent precipitation of dispersed nitride phases with a high dissociation temperature. (6 figures) (auth)

3985 INFLUENCE OF ORIENTATION ON SLIP AND STRAIN HARDENING OF MOLYBDENUM SINGLE CRYSTALS. Irwin, G. J.; Guiu, F.; Pratt, P. L. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi (a); 22: No. 2, 685-698(16 Apr 1974).

Molybdenum single crystals with axes along ⟨100⟩, ⟨110⟩, and ⟨111⟩ directions were deformed at 293 and 77°K. Techniques of slip line analysis and transmission electron microscopy were used to study the development of the deformation and dislocation substructure with strain. The existence of a slip asymmetry was confirmed and evidence was obtained for profuse cross-slip of screw dislocations over distances larger than atomic. Results suggested that edge dislocation segments have differing mobilities on different slip planes. No good explanation could be provided for the influence of orientation on the yield stress, but the work-hardening rate of crystals with different orientation was correlated with both the dislocation substructure and the development of slip line traces at the two temperatures investigated. (11 figures, 44 references) (auth)

3986 MOESSBAUER STUDIES OF Fe–Be, Fe–Nb, Fe–Ru, Fe–Te, AND Fe–Ir ALLOYS. Gupta, S.; Lal, K. B.; Srinivasan, T. M.; Rao, G. N. (Indian Inst. of Tech., Kanpur). Phys. Status Solidi (a); 22: No. 2, 707-713(16 Apr 1974).

The isomer shifts, quadrupole splittings, and magnetic hyperfine splittings of iron in α-Fe–Be: $FeBe_2$, ϵ-Fe–Nb, η-Fe–Nb, α-Fe–Ru, γ-Fe–Ru, $FeTe_2$, α-Fe–Ir, and γ-Fe–Ir alloys were measured using the Moessbauer effect. Some of these studies were carried out as a function of temperature in the temperature range 60 to 300°K. A possible new magnetic transition above 77°K in the ϵ-phase of the Fe–Nb (30 at. % Nb) alloy was found. In $FeTe_2$, a magnetic transition reported earlier from the susceptibility data is confirmed by these Moessbauer studies. Results are explained in terms of the electronic configuration and the structure of these alloys. (auth)

3987 COMPOSITION DEPENDENCE OF LATTICE PARAMETERS AND MAGNETIC MOMENTS OF F.C.C. $Co_{1-x}V_x$ ALLOYS. Aoki, Y.; Yamamoto, M. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 22: No. 2, K131-K133(16 Apr 1974).

Alloys containing up to 30.1 at. % V were prepared. Debye–Scherrer patterns show a fcc structure for > 14.2 at. % V and a metastable fcc structure for < 12.4 at. % V. The RT lattice parameters do not obey Vegard's law; they follow the equation $a_x = a_{Co}(1-x) + a_v x + C\mu_x$. Alloys < 20.7 at. % V are ferromagnetic above RT, alloys containing 21.6 to 22.8 at. % V become ferromagnetic at lower temperatures, while alloys > 24.2 at. % V are paramagnetic at 4.2°K. The mean saturation moment (μ_x) varies with x, decreasing linearly to 14 at. % V with a slope of 6 μ_B/V atom expected from the Friedel bound state model. (DLC)

3988 THERMAL CONDUCTIVITY OF LUTETIUM IN THE TEMPERATURE REGION FROM 0.7 TO 5K. Hajko, V.; Janos, S.; Feher, A.; Mlynek, R. (Safarik Univ., Czech.). Phys. Status Solidi (a); 22: No. 2, K143-K144(16 Apr 1974).

The thermal conductivity of Lu containing 0.1% Er, 0.07% Cu, etc., was measured by a steady-state heat flow method. The data between 0.7 and 5°K can be separated into a linear (αT) and a quadratic (βT^2) term, with α = 0.6 mW cm^{-1} deg^{-2} and β = 0.25 mW cm^{-1} deg^{-3}. No change in a magnetic field was observed up to 3.5 T. (DLC)

3989 ELECTRICAL RESISTIVITY OF SOLID AND LIQUID Gd AND Tb. Guentherodt, H. J.; Hauser, E.; Kuenzi, H. U.

(Eidgenoessische Technische Hochschule, Zurich). Phys. Lett.; 47A: No. 3, 189-190(25 Mar 1974).

The electrical resistivities of Gd and Tb were measured in the solid and liquid state. In the liquid state the values of the electrical resistivities are found to be 195μΩ cm for Gd and 190μΩ cm for Tb at their melting points. (auth)

3990 COMMENTS UPON "THE THERMOELECTRIC POWER OF SOME ThCe ALLOYS" AND AN ALTERNATE SUGGESTION. Foiles, C. L. (Michigan State Univ., East Lansing). J. Low Temp. Phys.; 14: No. 3-4, 229-241(Feb 1974).

Cooper and Rizzuto reported the thermoelectric power of ThCe and interpreted the behavior as the sole consequence of an impurity diffusion contribution. It was noted that PdRh and PtIr have similar qualitative behavior. The behavior of the PdRh system is quantitatively analyzed and produces results quite similar to those for ThCe. The larger context of several systems suggests that phonon-drag terms are important in ThCe. (auth)

3991 THERMOELECTRIC POWER OF SOME ThCe ALLOYS: A REPLY. Cooper, J. R. (Univ., Zagreb); Rizzuto, C. J. Low Temp. Phys.; 14: No. 3-4, 243-245(Feb 1974).

The authors present further evidence of the correctness of the model of thermoelectric power of ThCe alloys. It is also noted that the main contribution to the thermopower of ThCe arises from electron diffusion, and that this is connected with the instability of the $4f^1$ configuration in Ce, as are other properties, in particular the superconductivity and now the temperature-dependent resistivity. (JRD)

3992 MOESSBAUER EFFECT STUDY OF THE LAVES PHASE $NbFe_2$. Smith, A. W.; Rawlings, R. D. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi (a); 22: No. 2, 491-499 (16 Apr 1974).

Moessbauer spectra of ^{57}Fe in $NbFe_2$ were investigated as a function of composition and temperature (80 to 300°K). The prominent feature of the room-temperature spectra of $NbFe_2$ was a doublet due to the iron atoms (2a and 6h) on the iron sublattice. In addition, alloys in the composition range 65.9 to 69.7 at. % Fe exhibited a weak singlet corresponding to substitutional iron atoms, i.e. atoms on the niobium sublattice. At low temperatures, the iron-rich alloys showed evidence of a magnetic transition and the effective magnetic field was estimated to be 30 to 40 kOe. The homogeneity range at 1000°K was found to be 63 to 70 at. % Fe; the phase in equilibrium with $NbFe_2$ in alloys containing less than 63 at. % Fe is probably a μ-phase. (9 figures) (auth)

3993 STRUCTURE AND PROPERTIES OF CONTROLLED RECRYSTALLIZED NICKEL–TUNGSTEN EUTECTIC. Gorev, K. V.; Nesterovich, L. N.; Kupchenko, G. V. (Physical-Technical Inst., Minsk). Dokl. Akad. Nauk BSSR; 18: No. 1, 31-34(Jan 1974). (In Russian).

The eutectic in the Ni–W system consists of a solid solution of tungsten in nickel and of tungsten. The melting temperature of the eutectic is 1500°C. The pure eutectic structure is observed only at a content of 48 wt % tungsten in the alloy. Calculations show that the eutectic alloy contains about 9 vol % tungsten fibers. The method of Chokhral'skii was used to obtain directed crystallization of the eutectic. Rods 10 to 14 mm in diameter and up to 400 mm in length were obtained. The pulling rate varied from 4 to 10 cm/h. The eutectic crystallized with formation of a fiber structure. The tungsten fibers were parallel to each other and to the direction of crystallization of the matrix (solid solution of tungsten in nickel). Studies were made on the mechanical properties of the composite material at temperatures of 900 to 1100°C, and on the change in strength limit at T = 900°C as a function of the rate of crystallization. Over the entire temperature interval the short-term strength of the directed recrystallized eutectic was significantly higher than the strength of cast commercial alloys having a nickel base. (SJR)

3994 SLIP ON (110) IN (001) Nb SINGLE CRYSTALS DEFORMED IN COMPRESSION AT 77°K. Wasilewski, R. J. (National Science Foundation, Washington, DC); Hutchings, R.; Loretto, M. H. Phil. Mag.; 29: No. 3, 521-535(Mar 1974).

Single crystals of niobium were deformed in compression along (001) at 77°K to a few percent strain at several strain rates. The nature of the deformation was examined by optical, replica, scanning, and transmission microscopy. With the exception of the impact-loaded specimen the deformation occurred by highly regular (110) (111) slip on the four equi-stressed systems. Transmission electron microscopy has confirmed that the anomalous $(1\bar{1}0)$ surface offset observed is due to the simultaneous operation of the two ½ (111) dislocations on the appropriate (110) planes. (auth)

3995 CREEP IN STEELS USED FOR CONSTRUCTION AND WELDED JOINTS. Relaxation of Construction Steels. Boulisset, R.; Dollet, J. (Societe Creusot-Loire, Paris). Metaux (Corros.-Ind.); No. 579, 375-396(Nov 1973). (In French).

The macroscopic properties of creep in steels are reviewed. Examples are presented of research carried out for specialized fabrication processes: metallurgical problems associated with the optimizing of properties concerning the creep and brittle fracturing resistance of vapor turbine rotors and bolts; creep in welded assemblies; relation between deformation and stress under constant sigma and T stress conditions; post-welding heat treatments and relaxation of steels. (FR)

3996 EFFECT OF SURFACE-ACTIVE SUBSTANCES ON THE MECHANICAL PROPERTIES OF MOLYBDENUM AND TUNGSTEN. Naumova, L. M.; Murashkina, I. I. (Inst. of Chemistry, Tashkent). Uzb. Khim. Zh.; No. 1, 10-11(1974). (In Russian).

The change in the surface tension of Mo and W during processing in vaseline oil with surface-active substances was studied. The different magnitude of the effect of the adsorption alleviation of the deformation on the (100) and (110) faces was established. (tr-auth)

3997 LANTHANUM–NICKEL–BORON SYSTEM. Kuz'ma, Yu. B.; Bilonizhko, N. S.; Nimkovich, E. M. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; 35: 939-941(Oct 1973). (In Ukrainian).

Radiation Effects

Refer also to abstracts 2983, 3853, and 4412.

3998 (CONF-710342-, pp vp Paper 14) IRRADIATION INVESTIGATIONS OF THE HEAVY SECTION STEEL TECHNOLOGY PROGRAM. Witt, F. J. (Oak Ridge National Lab., TN). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Investigations of the effects of fast-neutron irradiation on ASTM A 533, grade B, class 1 steel are being carried out under the auspices of the Heavy Section Steel Technology (HSST) Program. The objectives are to evaluate the effects of irradiation on the fracture behavior of pressure vessel steels and vessels fabricated from such steels, taken singly and in combination with in-service related factors such as fatigue, strain aging, stress corrosion cracking, and possibly other embrittling factors; to validate applicability of the fracture technology developed under other tasks of the HSST program in combination with the additional parameter of irradiation; to obtain valid fracture toughness K_{Ic} values at as high a temperature as possible; to determine lower bound K_{Ic} values under conditions for which actual K_{Ic} measurements are impossible or not feasible; to recommend and develop the part that irradiation should play in carrying out the simulated service tests; and to develop a panacea for the toleration of irradiation as affecting the design of nuclear vessels. The irradiation investigations are divided into seven categories as follows: basic data, higher temperature, environmental effects, dose rate, spectrum, surveillance, and simulated service test. Emphasis has been placed on the basic data and higher temperature investigations. The environmental effects and surveillance activities have been initiated. The overall status of the irradiation effects activity is summarized and placed in perspective with the rest of the total HSST effort. (auth)

3999 (CONF-710342-, pp vp Paper 15) STATE OF COOPERATIVE EFFORTS BETWEEN THE HSST PROGRAM AND THE PRESSURE VESSEL STEEL IRRADIATION PROGRAM OF VEREIN DEUTSCHER EISENHUETTENLEUTE (VDEh). Sievers, G. (Kernforschungsanlage, Juelich, Ger.). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

An informal cooperative effort for investigating the effects of irradiation on steels exists between the technical personnel of Institut für Reaktorwerkstoffe and the HSST program. The status of this cooperative effort is summarized and the irradiation equipment and its performance during irradiation are described. A submerged arc weld was made from the 12-in.-thick HSST Plate Section 03J. Results from impact tests, tensile tests, and hardness measurements are presented for unirradiated samples. (auth)

4000 (CONF-710342, pp vp Paper 16) RELATIVE DYNAMIC TEAR AND CHARPY-V CHARACTERISTICS OF IRRADIATED A533B PLATES AND WELD METAL FROM THE AEC HSST PROGRAM. Hawthorne, J. R.; Watson, H. E. (Naval Research Lab., Washington, DC). 1971.

From 5th annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

Charpy-V (C_v) and dynamic tear (DT) test comparisons have been developed for the irradiated condition of two 12-in.-thick A 533-B steel plates and a submerged arc weld deposit. Individual plates were identified as HSST program plates 01 and 02; the weld was identified as weld 50. Low temperature (<300°F) and elevated temperature (550°F) irradiations were conducted. Test specimens were taken from plate 01 in the transverse (WR) orientation only; specimens were taken from plate 02 in both longitudinal (RW) and transverse (WR) orientations. Specimens from weld 50 were removed from the larger of the two welded grooves forming the 2:1 offset double-U weld joint and were oriented with the long specimen axis perpendicular to the welding direction. Approximately the same neutron fluence level was obtained in each experiment ($2.5 \times 3.3 \times 10^{19}$ n/cm^2 > 1 MeV). Shelf observations are in agreement with recent findings for A 543, A 302-B, and other A 533 steel plates which illustrate a DT to C_v shelf energy ratio of 8.0:1 for pre- and post-irradiation conditions. Post-irradiation C_v and DT mid-energy transition temperature increases were found comparable for both plate and weld deposit (quarter thickness position evaluations). Observed Charpy-V 30 ft-lb transition temperature increases are compared with the performances of the ASTM A 302-B reference plate and several other A 533 steels. Radiation embrittlement sensitivity at 550°F increases with increasing copper content as expected; however, embrittlement sensitivities of all three materials exceeded expectations. Results are compared with the performance of a 30-ton A 533-B demonstration melt (6-in. plate) tailored for improved radiation embrittlement resistance. (auth)

4001 (CONF-710342-, pp vp Paper 17) NEUTRON FLUENCE EFFECT ON THE FRACTURE AND TENSILE PROPERTIES OF ASTM A533B PRESSURE VESSEL STEEL. Williams, J. A.; Hunter, C. W. (Hanford Engineering and Development Lab., Richland, WA). 1971.

From fifth annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The K_{Ic} fracture toughness of ASTM A 533, grade B, class 1, pressure vessel steel from HSST plate 02 was studied after irradiation to fluences of 2 and 8×10^{19} n/cm^2 (E > 1 MeV); irradiation embrittlement at the respective fluences yielded K_{Ic} fracture toughnesses of 50 ksi $\sqrt{\text{in.}}$ at temperatures 230 and 350°F higher than for unirradiated material. The fatigue crack preparation stress intensity was cursorily examined as to its effect on K_{Ic} fracture toughness. Unirradiated material room temperature fatigued at 10 ksi $\sqrt{\text{in.}}$ and tested at lower temperatures exhibited lower fracture toughness than earlier data obtained with cracks prepared under less conservative criteria; a fracture toughness of 50 ksi $\sqrt{\text{in.}}$ was obtained at a 60°F higher test temperature with cracks prepared at low level fatigue stress intensity. Tensile properties of A 533-B were evaluated over a temperature range from −320 to 500°F in unirradiated condition and for material irradiated to fluences of 2, 4, 6, and 8×10^{19} n/cm^2. Yield strength increased 44, 56, 61, and 79 percent with respect to these fluences. The irradiation sensitivity of the ultimate strength, a 30 percent increase at 2×10^{19} n/cm^2 and a 50 percent increase at 8×10^{19} n/cm^2, was less than that of the yield strength; thus the margin between flow and failure is decreased with increasing irradiation. The changes in yield and ultimate strength are proportional to the fluence, and no saturation of irradiation strengthening is evident in the range of investigation. The combination of temperature below −240°F and fluences above 6×10^{19} n/cm^2 elevates the tensile yield strength to the fracture stress, resulting in brittle cleavage with no plastic deformation at a stress of 170 ksi. (auth)

4002 (CONF-710342-, pp vp Paper 18) EVALUATION BY LINEAR ELASTIC FRACTURE MECHANICS OF RADIATION DAMAGE TO PRESSURE VESSEL STEELS. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1971.

From fifth annual information meeting of the heavy section steel technology program; Oak Ridge, Tennessee, USA (25 Mar 1971).

In fifth annual information meeting on heavy section steel technology program.

The fracture toughness (K_{Ic}) properties were generated for A 533, grade B, class 1 steel plate and submerged arc weldment material in the post-irradiation condition ($2-6 \times 10^{19}$ n/cm^2, E > 1 MeV, irradiated around 550°F). Tensile properties were also generated for the plate material under the same conditions of neutron exposure. In addition, the post-irradiation fracture toughness from one test performed on A 508, class 2 steel is presented. The results indicate the post-irradiation fracture toughness properties to be highly temperature dependent, i.e., they exhibit the same transition temperature shift as the 30 ft-lb "fix" Charpy transition temperature. Included is a recommendation as to a future post-irradiation test program. The high levels of post-irradiation fracture toughness provide assurance of the integrity of heavy-section, nuclear pressure vessels. Based on the recommendation as to a future post-irradiation test program, a 4-in.-thick dummy specimen will be placed in the Babcock and Wilcox Test Reactor. The purpose of the dummy specimen is to measure the effect of gamma heating on the temperature gradient throughout the specimen. Progress to date is reported. (auth)

4003 HIGH TEMPERATURE DEFORMATION OF FUEL ELEMENT CLADDINGS. Dupouy, J. M. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 277: No. 24, 1303-1306(17 Dec 1973). (In French).

The deformation of hyperquenched 316 steel fuel element cladding was observed and studied. This deformation occurs at high temperatures and rapidly increases with irradiation dose and temperature. The formation of large cavities (preferentially on carbides and intermetallic phases) accounts for a considerable part of this deformation. (FR)

4004 EFFECT OF NEUTRON IRRADIATION ON PROPERTIES OF WEDGE-SHAPED TWINS IN BISMUTH CRYSTALS. Bashmakov, V. I.; Bosin, M. E.; Varik, V. I. (Kharkov Inst. of Public Supplies). Strength Mater. (USSR) (Engl. Transl.); 5: No. 4, 477-479(Apr 1973).

Translated from Probl. Prochnosti; 5: No. 4, 80-82(Apr 1973).

Radioinduced twinning in Bi crystals was studied. It was found that irradiation of bismuth crystals by fast neutrons leads to a substantial change in the properties of twinning boundaries, the elastic detwinning effect is increased, the time-dependent deformation relaxation at the twinning boundaries is increased several-fold, and the hardening concentrated at the boundaries during growth of the twins is stabilized. (auth)

4005 DEPENDENCE OF ELECTRON DAMAGE ON CRYSTAL ORIENTATION IN THE HVEM. Doyle, P. A. (Univ. of Bristol, Eng.). Phys. Metals Metallogr. (USSR) (Engl. Transl.); 29: No. 3, 537-545(Mar 1974).

Irradiation of Cu and Fe by fast electrons in a high-voltage electron microscope is known to produce visible damage preferentially at certain crystallographic orientations. Concepts from the semiclassical theory of electron diffraction are used, in addition to the usual Bloch wave approach, in describing this direction dependence. The damage rate is enhanced by a factor of up to 2.6 at the center of Cu (220) bend contours at 600 kV, due to the large excitation of the most strongly bound state. The width of the denuded zone at the top surface is found to be important in determining which systematic orientations produce well-defined bands of damage. The absence of damage patterns for many orientations of Fe is discussed. No marked increase in visible damage is expected for electrons incident close to principal crystal directions. (auth)

4006 THEORY OF IRRADIATION-INDUCED PRIMARY CREEP IN CRYSTALLINE SOLIDS. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Phys. Metals Metallogr. (USSR) (Engl. Transl.); 29: No. 3, 679-683(Mar 1974).

Development of a theory for the creep rate of materials under stress during bombardment with energetic particles was continued. The equations for the viscoelastic primary-creep strain-tensor were derived and compared with relevant data. A reasonable measure of agreement was found. (auth)

4007 ADSORPTION OF METAL VAPOR IN THE PRESENCE OF ION IRRADIATION. Babaev, V. G.; Guseva, M. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2596-2601(Dec 1973). (In Russian).

The role of the parameters of ion currents in the formulation of the critical characteristics in condensation processes and of the film structure grown during precipitation of the material from the vapor phase under conditions of ion irradiation is studied. An explanation of the mechanism of ion stimulation is proposed. (tr-auth)

4008 ELECTRON-MICROSCOPE OBSERVATION OF RADIATION DAMAGE IN VANADIUM. Takaku, H. (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku; No. 72007, 1-17(Jul 1972). (In Japanese).

Pure vanadium, vanadium containing about 700 ppM carbon and vanadium containing about 600 ppM boron, were irradiated in JRR-2, up to a fast neutron fluence of 2.0×10^{19} n/cm^2 and a thermal neutron fluence of 2.0×10^{20} n/cm^2, at reactor ambient temperature of about 70°C. Behaviors of induced defects are observed using a transmission electron-microscope after annealing at eight different temperatures ranging from 560 to 1300°C. Under the as-

irradiated condition, the diameter and the density of defect clusters are observed to be about 80 Å and about $2.0 \times 10^{16}/cm^3$, respectively. By post-irradiation annealing at 560°C, these clusters grow into clearly visible dislocation loops in pure vanadium (150 Å in dia, $4.2 \times 10^{15}/cm^3$ in density) and in vanadium containing carbon (250 Å dia, $3.0 \times 10^{15}/cm^3$ density), respectively. These dislocation loops interact with each other and result into dislocation lines, and anneal out by heat-treatments at higher temperature. Severely damaged regions are produced by the transmutation reaction of thermal neutron-activated boron, $^{10}B(n,\alpha)^7Li$, in vanadium containing boron. The damage remains at comparatively high temperature. There are observed bubbles resulting from the agglomeration of helium (α-particle) produced through the $^{10}B-(n,\alpha)^7Li$ reaction, by annealing at 1200°C and above. (auth)

4009 RELATIONSHIP OF HIGH-TEMPERATURE RADIATION EMBRITTLEMENT OF AUSTENITIC STAINLESS STEELS AND NICKEL-BASE ALLOYS TO FOCUSSING PROCESSES. Razov, I. A.; Ul'pe, L. R.; Shokhor, L. D. At. Energ. (USSR); 36: No. 3, 182-185(Mar 1974). (In Russian).

The focused-helium theory of high-temperature radiation embrittlement of austenitic stainless steels and nickel-base alloys is examined. The theory is based on the formation of unstable helium bubbles by the reaction $^{10}B(n,\alpha)^7Li$; the thermal neutrons obtain the kinetic energy of the focused particles during the interaction of intermediate neutrons with crystal lattice atoms. The solution of the equation relating bubble radius and internal pressure to neutron fluence, the number of helium atoms formed, and other parameters shows close agreement with known experimental data. (tr-auth)

4010 ABSORPTION OF BETA PARTICLES IN ALUMINIUM. Thontadarya, S. R.; Umakantha, N. (Karnatak Univ., Dharwar, India). Indian J. Pure Appl. Phys.; 11: No. 8, 629-631(Aug 1973).

The quantity f/t where f is the fraction of the incident number of beta particles that get completely absorbed in a foil of thickness t is experimentally found to decrease exponentially with the foil thickness over a limited range of thickness, in the case of aluminum. This decrease is characterized by a new mass absorption coefficient which is found to be closely related to the mean energy loss of electrons in aluminum. (auth)

4011 METHOD FOR INDUCING RESISTANCE TO EMBRITTLEMENT BY NEUTRON IRRADIATION AND PRODUCTS FORMED THEREBY. Martin, W. R.; Weir, J. R. (to United States Atomic Energy Commission). US Patent 3,804,680. 16 Apr 1974. Filed date 8 Aug 1972. 10p.

Metals and alloys containing incidental amounts of boron are doped with a boride-forming element (Ti, Zr, Hf) in an amount effective to induce formation of an intragranularly dispersed precipitated phase at elevated temperatures to produce a product having enhanced resistance to radiation-induced embrittlement at high temperatures. Examples are given of application to stainless steels (particularly Type 304) and Hastelloy N. (Official Gazette)

4012 METHOD FOR INDUCING RESISTANCE TO EMBRITTLEMENT BY NEUTRON IRRADIATION AND PRODUCTS FORMED THEREBY. Martin, W. R.; Weir, J. R. (to United States Atomic Energy Commission). US Patent 3,804,680. 16 Apr 1974. Filed Date 8 Aug 1972. 10p.

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4013 VOLUME AND ELECTRICAL RESISTIVITY CHANGE IN NIOBIUM AFTER NEUTRON IRRADIATION AT 4.6 K. Doenitz, W. (Technische Hochschule, Darmstadt, Ger.); Hertz, W.; Waidelich, W.; Peisl, H.; Boening, K. Phys. Status Solidi (a); 22: No. 2, 501-510(16 Apr 1974).

Pure niobium single crystals and wires were irradiated at 4.6°K by fast neutrons. Lattice parameter change $\Delta a/a$ and resistivity change $\Delta\rho$ were determined simultaneously at 4.2 and 9.2°K, respectively, and recovery was studied by an isochronal annealing program. The defect-specific ratio of both property changes was found to be $(\Delta a/a)/\Delta\rho = (0.25 \pm 0.015) \times 10^3\ (\Omega cm)^{-1}$. The volume change and resistivity change due to a Frenkel defect are discussed. For the recovery behavior, a model in analogy to that known for fcc metals is given. The small differences in the recovery of lattice parameter and resistivity can be essentially interpreted by different impurity contents of the samples. (43 references) (auth)

4014 EFFECT OF COMPOSITION ON THE SENSITIVITY OF STRUCTURAL STEEL TO IRRADIATION EMBRITTLEMENT. Powers, A. E. (Knolls Atomic Power Lab., Schenectady, NY). Contract W-31-109-Eng-52. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 31-38(1973). (KAPL-P-3941).

About 75 low alloy steels that have been irradiation tested at 450 to 550°F have been chemically analyzed for copper, aluminum, total nitrogen, and combined nitrogen. Uncombined nitrogen content has been found to have a strong modifying action on the effectiveness of copper in controlling sensitivity to irradiation embrittlement at 450 to 550°F. (auth)

Other Materials

Refer also to abstracts 2631, 2714, 2746, 2777, 2844, 3093, 3935, 5408, 5503, 5787, 5801, and 5807.

4015 (AECL-4058) IRRADIATION BEHAVIOUR OF U_3Si ELEMENTS TO HIGH BURNUP. Feraday, M. A.; Cotnam, K. D.; Fehrenbach, P. J.; Morel, P. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1973. 27p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

The dimensional stability of fuel elements clad in zirconium alloy sheaths and containing U_3Si with an axial void was demonstrated to be satisfactory for use in power reactor fuel bundles to burnups in excess of 400 MWh/kgU. Elements were irradiated at constant power outputs in the range 50 to 69 kW/m to burnups of 240 MWh/kgU. Other elements initially at high power operated at varying powers between 84 and 58 kW/m (time average 68 kW/m) to burnups as high as 455 MWh/kg U. The maximum diameter increases in these elements were about 1.2%. The swelling in U_3Si irradiated at constant coolant temperature, reaches a steady-state level which is a function of power output and external restraint. At steady state, an increase in power will cause an increase in element diameter over a period of weeks. A reduction in the external restraint will cause an increase in the swelling of U_3Si. (10 figures) (auth)

4016 (CONF-720724-P1, pp 73-79) EFFECTS OF HEAVY ION RADIATION ON QUARTZ GLASS. Kraetschmer, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Various heavy ions, i.e., from oxygen to iodine, with about 40 MeV energy and 20 keV electrons were used to irradiate quartz glass. The compaction and the etching properties of the irradiated quartz glass were studied as a function of track density and dose. Information was thereby obtained about the distribution of radiation damage of a single ion along its path. It was determined that with sufficiently high dose, electrons and heavy ions can generate similar damage effects, but characteristic differences exist in their etching behavior and the degree of compaction at saturation. (auth)

4017 (CONF-720724-P1, pp 152-177) ELECTRON PARAMAGNETIC RESONANCE IN SILVER HALIDE. Trukhin, M. I.; Shelekhin, Yu. L. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The paramagnetic silver gas (free silver atoms) of a natural mixture of silver isotopes ^{109}Ag and ^{107}Ag is stabilized in the crystal silver halides synthesized in the silver ion excess, and irradiated by 1-GeV protons at 77°K. The ESR spectrum of free silver atoms for the isotope mixture consists of four lines placed in pairs from the free electron line with g-factor of 2.00. In the silver halides irradiated by protons, other paramagnetic centers the nature of which is under discussion have also been observed. (auth)

4018 (CONF-740501-, pp 288-305) STATUS OF GRAPHITE TECHNOLOGY AND REQUIREMENTS FOR HTGR'S. Engle, G. B. (General Atomic Co., San Diego, CA); Everett, M. R.; Eatherly, W. P. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The current status of graphite technology as it relates to core graphites for large High-Temperature Gas-Cooled Reactors (HTGRs) is discussed. The graphite data are reviewed in terms of three types of materials: anisotropic needle-coke; near-isotropic coke; and high-strength, fine-grained isotropic graphites. Opinions in Europe and the U. S. have converged recently and development is now being aimed at near-isotropic graphites, which appear to have satisfactory properties and performance while having the added asset of being manufactured by conventional methods at relatively low costs. Near-isotropic graphites are

currently undergoing extensive evaluation in Europe and the U. S. Porperty measurements and irradiation experiments are being accelerated to characterize these materials for design and safety analyses. Initial results, including property and irradiation data to about 8×10^{21} n/cm^2 at 1000° to 1200°C, indicate the near-isotropic graphites are similar to Gilsocoke materials and thus should be satisfactory for large HTGR design. These materials should permit longer core life at higher temperatures than are now available with anisotropic materials. Experimental and theoretical studies that are receiving increasing attention are: development of stress-strain failure criteria; determination of irradiation creep characteristics; effects of irradiation on strength; irradiation temperature history effects; oxidation resistance; and development of standard methods of test for properties. The state of the graphite technology is constantly being surveyed to determine the requirements of the core graphite for advanced HTGRs. It is anticipated that the current generation of near-isotropic graphites will be improved to meet the requirements of these advanced reactors and no unsolvable problems are forseen at present. (auth)

4019 PREPARATION AND CRYSTAL GROWTH OF ThF_4. Pastor, R. C.; Arita, K. (Hughes Research Labs., Malibu, CA). Mater. Res. Bull.; 9: No. 5, 579-584(May 1974).

ThF_4 powder is hygroscopic but the uptake of H_2O does not lead to hydration or hydrolysis at ordinary temperatures. The crystal hydrolyzes at ~350°C, making congruent growth from the melt at 1120°C sensitive to the presence of H_2O in the vapor phase. The crystal grown under HF yields a melting point which is ten degrees higher than the highest value reported in the literature. (auth)

4020 ENERGY SPECTRUM OF Dy^{3+} ION IN SINGLE CRYSTALS OF THE $KY(MoO_4)_2$-$KDy(MoO_4)_2$ SYSTEM. Stetsenko, T.S.; Pshisukha, A.M.; Elchaninova, S.D.; Zvyagin, A.I. Opt. Spectrosc. (USSR) 34: No. 2, 227-228 (Feb 1973).

4021 SOME ELECTRICAL AND OPTICAL PROPERTIES OF CHROMIUM-, MOLYBDENUM- AND TUNGSTEN-NITRIDE LAYERS. Cherezova, L.A.; Kryzhanovskii, B.P. Opt. Spectrosc. (USSR) 34: No. 2, 234-236 (Feb 1973).

4022 RADIATION DAMAGE IN CaF_2 AND BaF_2 INVESTIGATED BY THE CHANNELING TECHNIQUE. Hellborg, R.; Skog, G. (Univ. of Lund, Sweden). Phys. Scr.; 9: No. 2, 121-127(Feb 1974).

Damage in single crystals of CaF_2 and BaF_2 induced by room-temperature bombardment with 2.0-MeV helium ions was studied by the channeling technique. Backscattering spectra for the ⟨111⟩ and ⟨110⟩ axial directions were taken after different doses of random irradiation. A slight increase of the aligned yield with radiation dose was found for both crystals at doses below 10^{17} ions/cm^2. For CaF_2 at a dose of about 1.4×10^{17} ions/cm^2, a steep increase was found, after which the aligned yield saturates at a high value. Analyses of spectra measured along different aligned directions indicate that the structures of defects in CaF_2 and BaF_2 differ. (auth)

4023 SELECTIVE TRAPPING METHOD. Study of Defects and Diffusion Phenomena. Brelot, A. (Ecole Normale Superieure, Paris). J. Phys. (Paris), Colloq.; No. 5, 67-75(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Irradiation and implantation both produce the displacement of atoms and the production of equal numbers of interstitials and vacancies. It is, in consequence, difficult to distinguish from which of these defects a particular phenomenon arises. The only technique available for determining the nature of defects (vacancy or interstitial) is ESR; this technique permits only defects which are associated with an unpaired electron to be detected. It was shown that the response of a semiconductor to irradiation is very often dominated by the nature and concentration of electrically neutral impurities such as carbon or oxygen. A method was subsequently developed for quantitatively measuring defect-impurity interactions. The nature of the defect (interstitial or vacancy) can be reliably determined by selectively trapping vacancies on suitable impurities. In reality, the vacancy concentration likely to react with other impurities in such a sample is very much smaller than that created in samples which do not contain selective traps. In this way, a complete table was established for the interaction of simple defects with electrically neutral impurities in silicon (oxygen, carbon, tin, germanium). Two examples are given (silicon-interstitial carbon pair; silicon-interstitial oxygen pair) which indicate the preciseness of the information obtainable. This method has a vast domain of possible applications which might include fundamental studies of the diffusion processes. (FR)

4024 DEGRADATION OF OPTICAL MATERIALS SPATIAL ENVIRONMENTS. Defect Production Mechanisms. Romero, M. (Univ., Toulouse). pp 243-247 of Third Meeting on Spatial Optics. Paris; Centre National d'Etudes Spatiales (1971). (In French).

From 3rd meeting on spatial optics; Marseille, France (21 Sep 1971).

Optical systems are analyzed in order to determine which materials are subject to degradation when exposed to ionizing radiations and charged particles. The various mechanisms involved in the production of defects are exposed: production of vacancies by collisions (metals, glasses, semiconductors, and covalent compounds); production of vacancies by ionization in ionic crystals; molecular dissociation. The effect of the different characteristics of the radiation (nature and simultaneity; energy and dose rate; temperature of the sample) is discussed. (FR)

4025 TERNARY SYSTEM KPO_3–WO_3–MoO_3. Semenyakova, L. V.; Kokarovtseva, I. G. (Siberian Metallurgical Inst., Stalinsk, USSR). Zh. Neorg. Khim.; 18: No. 11, 3068-3071(Nov 1973). (In Russian).

Thermographic and x-ray methods were used to study the KPO_3–WO_3–MoO_3 system which is a stable section of the quaternary system K_2O–P_2O_5–WO_3–MoO_3. A number of new compounds were detected. Compound A has a composition $K_2O \cdot P_2O_5 \cdot MoO_3$, melts at 702°C, and has a heat of fusion of 4.39 kcal/mol, a density of 2.943 g/cm^3, and refractive indices of 1.684 and 1.606. Compound B had a composition $K_2O \cdot P_2O_5$–WO_3, melts at 750°C, and has a heat of fusion of 2.83 kcal/mol, a density of 3.744 g/cm^3 and refractive indices of 1.670 and 1.594. Compound C has a composition $K_2O \cdot P_2O_5 \cdot 2MoO_3$, melts at 716°C, and has a heat of fusion of 4.25 kcal/mol, a density of 3.250 g/cm^3 and refractive indices of 1.711 and 1.669. Compound D has a composition $K_2O \cdot P_2O_5 \cdot 6MoO_3$, melts at 640°C, and has a heat of fusion of 4.89 kcal/mol, a density of 3.665 g/cm^3 and refractive indices of 1.900 and 1.900. Compounds A and B are isomorphous as shown by the similarity of their Roentgenograms, and form a continuous series of solid solutions within the ternary system. A phase diagram of the ternary system is presented. Compositions and melting temperatures of invariant points are as follows: 660°C (60% KPO_3, 1.5% WO_3 and 38.5 mol % MoO_3), 598°C (33% KPO_3, 1.5% WO_3 and 65.5 mol % MoO_3), 614°C (21% KPO_3, 1.5% WO_3 and 77.5 mol % MoO_3), and 610°C (34% KPO_3, 2% WO_3 and 64 mol % MoO_3). (SJR)

4026 DEFECTS CAUSED IN EMITTERS BY ELECTRONS AND THEIR ROLE IN PROCESSES OF REDUCTION OF THE COEFFICIENT OF SECONDARY ELECTRON EMISSION. Tyutikov, A. M.; Toiseva, M. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2557-2561(Dec 1973). (In Russian).

Results are reported of the study of the change in the coefficient of secondary electron emission and in the quantum yield of the photoeffect of MgO layers during its irradiation with electrons. At room temperature the change in the coefficient of secondary electron emission is explained by the appearance of color centers in the oxide layer. The coloring mechanism is discussed. (tr-auth)

4027 PASSAGE OF FAST ELECTRONS THROUGH NaCl MONOCRYSTALS. Kaplin, V. V.; Bobudaev, A. Ya.; Vorob'ev, S. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2603-2604 (Dec 1973). (In Russian).

The passage of 2.0-MeV electrons in NaCl monocrystals with a thickness of 110 μm is studied. Results are explained in the framework of the continuous model by the effects of electron channeling and the focusing of electrons on the nuclear chain and the monocrystal plane. (tr-auth)

4028 PHOTOCONDUCTIVITY EXCITATION AND QUENCHING SPECTRA OF ELECTRON-IRRADIATED CdS SINGLE CRYSTALS IN AN INFRARED REGION. Yoshida, T.; Oka, T.; Kitagawa, M. (Radiation Center of Osaka Prefecture, Sakai). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 65-72(Mar 1973).

Photoconductivity excitation and quenching spectra of CdS single crystals irradiated with 10-MeV electrons were studied. The monochromatic light chopped doubly with frequencies of 13 and 150 Hz and lock-in amplifier systems were used. Measurement was made at various temperatures from liquid nitrogen temperature to room temperature under illumination with bias light of 0.53 μ at different intensities. There are found the excitation bands around 0.93, 1.1, and 1.7 μ produced by irradiation, and the quenching bands around 0.76, 0.9, 1.2, and 1.4 μ. The quenching band around 1.2 μ seems to be sensitive to irradiation. The excitation bands decrease in magnitude at high temperatures. (auth)

4029 SECONDARY EMISSION INVESTIGATION OF STRUCTURAL DEFECTS IN Ge CRYSTALS IRRADIATED BY INERT-GAS IONS. Abroyan, I. A.; Belyakov, V. S.; Titov, A. I.; Shul'bakh,

V. A. (Leningrad Polytechnical Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2605-2608(Dec 1973). (In Russian).

The dependence (D), the relative size of the peaks on the curve after irradiation of the target with a given dose D, is studied on Ge crystals irradiated with Ne^+, Kr^+, and Xe^+ ions at energy from 1 to 10 keV. The dependence on the ion energy, ion current density, temperature of the sample, and energy of the transmitted electrons is determined. Results show that these parameters characterize the formation and annealing of structural defects in Ge monocrystals during bombardment with ions. (JSR)

4030 THEORY OF THE INTERACTION OF ION BEAMS WITH CRYSTALS. Kumakhov, M. A.; Muralev, V. A. (Scientific-Research Inst. of Nuclear Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2585-2589(Dec 1973). (In Russian).

A calculation is made of the spatial distribution of interstitial ions and radiation defects during channeling of ion beams. A calculation is also made of the radiation cascade in solids. The distribution of the current of the channeled beam within the lattice cell is studied. (tr-auth)

4031 ELECTRON SPIN RESONANCE STUDIES OF X-RAY IRRADIATED SINGLE CRYSTALS OF FERROELECTRIC KH_2PO_4 AND KD_2PO_4. Kocheril, G. P. St. Louis; St. Louis Univ. (1973). 130p. University Microfilms Order No. 74-4538.

Thesis (Ph. D.).

An experimental and theoretical report is presented on the electron spin resonance studies of x-ray irradiated single crystals of potassium dihydrogen phosphate (KH_2PO_4) and the deuterated crystal, potassium dideuterium phosphate (KD_2PO_4). The crystals were irradiated with 50kV x-rays at liquid nitrogen temperature (77°K) and ESR investigations were made at a microwave frequency near 9 GHz (x-band) without allowing the crystals to warm up. The experimental results have been compared with the existing ones and improvements made. The additional hyperfine lines observed in the ESR spectra, under the present investigations have been grouped and analyzed. A neutral hydrogen doublet, a four line hyperfine structure and two phosphorus hyperfine interactions with large coupling constants have been observed for the first time in the spectra of KH_2PO_4. In the case of KD_2PO_4 the additional interactions observed are: a deuterium hyperfine triplet, a four line hyperfine structure and four sets of phosphorus hyperfine doublets. The hydrogen doublet and the deuterium triplet lines show further structure due to interactions with phosphorus nuclei. The four line hyperfine structure observed in the spectra of both KH_2PO_4 and KD_2PO_4 have many features, such as field position, line width and angular dependence in common. The only observable difference is that proton hyperfine lines are resolved in the case of KH_2PO_4 for the magnetic field H parallel to the tetragonal c-axis of the crystal, whereas the deuteron hyperfine structure is unresolved in the case of KD_2PO_4. The rotation data reveals the orthorhombic symmetry of this center. To a good approximation the center possesses cylindrical symmetry about the c-axis. An analysis of the four line hyperfine structure is made for the cylindrical symmetry. The calculated and experimental line positions agree within 10 gauss. One of the phosphorus hyperfine centers (P_1-center) is found to have a hyperfine coupling tensor axially symmetric about a phosphorus-oxygen bond in the crystal. For this center, $A_\parallel \simeq 2060$ gauss and $A_\perp \simeq 1610$ gauss, probably the largest phosphorus hyperfine coupling constants reported up to this time. Experimental data are presented on the power and angular dependences of the spectral lines. Wherever possible, estimates of the g-tensor and hyperfine coupling tensor have been obtained. In conclusion, a few recommendations are made for further experiments in this type of crystals. (Diss. Abstr. Int., B)

4032 VIBRATIONAL PROPERTIES OF ION-IMPLANTATION DOPED SILICON. Morhange, J. F.; Beserman, R.; Sebenne, C.; Balkanski, M. (Univ., Paris). J. Phys. (Paris), Colloq.; No. 5, 99-102(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Raman spectroscopy was used to study the vibrational properties of silicon implanted with Si, P, A, Ga, and As. The implantation doses varied from 10^{13} to 10^{16} ions/cm^2 (80 keV). The energy loss per unit volume due to nuclear processes was determined: $2.5 \cdot 10^{24}$ eV/cm^3. The depth of silicon which became amorphous varied between 500 and 1000 Å. The recovery temperature varied between 550 and 595°C. (FR)

4033 STUDY OF COLOR CENTERS WITH TERNARY SYMMETRY IN AN X-RAY IRRADIATED $KZnF_3$ CRYSTAL. Rousseau, J. J.; Binois, M.; Fayet, J. C. (Centre Univ., Le Mans, France). Compt. Rend., Ser. A, B; 277: No. 20, 617-620(19 Nov 1973). (In French).

The x-ray irradiation of a $KZnF_3$ crystal at various different temperatures leads to F and V_K color centers and to a C_{3v} symmetry defect which is probably associated with an impurity. (FR)

4034 COMPOSITION FOR PREPARING GRAPHITE BODIES. Hammer, R. L.; Napier, J. M.; Stooksbury, E. W.; Strehlow, R. A. (to United States Atomic Energy Commission). US Patent 3,798,161. 19 Mar 1974. Filed date 10 Nov 1970. 6p.

A graphitizable composition is described that can be extruded at low temperatures to form a shaped article which upon carbonization yields a body having an open porosity of up to 30 percent as measured by mercury porosimetry. The composition is further characterized in that it comprises a homogeneous mixture of graphite or graphitizable filler material and a liquid binder consisting essentially of polymerized isotruxene and acenaphthylene. (Official Gazette)

4035 OPTICAL ABSORPTION EDGE IN IMPROPER FERROELECTRICS IN THE PHASE TRANSITION REGION. Fridkin, V. M. (Inst. of Crystallography, Moscow); Verkhovskaya, K. A.; Bochkov, B. G. Phys. Status Solidi (a); 22: No. 2, 759-766(16 Apr 1974).

The energy gap temperature dependence in some improper ferroelectrics (gadolinium) molybdate and boracite: $Fe_3B_7O_{13}Br$, $Fe_3B_7O_{13}Cl$, $Mg_3B_7O_{13}Cl$, $Co_3B_7O_{13}Cl$, $Zn_3B_7O_{13}Cl$, $Cr_3B_7O_{13}Cl$) was investigated. The temperature behavior of E_g was found to be different for the investigated crystals in accordance with the peculiarities of the corresponding phase transitions. It is shown that some experimental results are in agreement with predictions of the thermodynamic theory for improper ferroelectrics. (5 figures) (auth)

4036 INVESTIGATIONS OF THE DYNAMICAL COLORATION BEHAVIOR OF CERIUM-OXIDE-DOPED ALKALINE EARTH FLUORIDE CRYSTALS. Bernhardt, H.; Goerlich, P. Phys. Status Solidi (a); 22: No. 2, 559-568(16 Apr 1974).

The dynamical characteristics of the spectroscopically investigated $CaF_2:CeO_2$ and $SrF_2:CeO_2$ crystals are regarded and discussed. $CaF_2:CeO_2$ and $SrF_2:CeO_2$ show different dynamical behavior types and are described by different analytical functions. This is true for the RT and LNT coloration processes. The RT discoloration is, as expected, for both the host lattices from the same type. The dynamical behavior investigations give information about the concentrations of donors and acceptors and the kind of electron transfer. (7 figures) (auth)

4037 CORRELATED CHANGES OF FLOW STRESS AND OPTICAL ABSORPTION IN KBr γ-RAYED AT LNT. Naramoto, H. (Japan Atomic Research Inst., Tokai-mura); Ozawa, K.; Okada, T.; Suita, T. Phys. Status Solidi (a); 22: No. 2, 445-453 (16 Apr 1974).

The coloring and hardening behaviors were simultaneously studied in nominally pure KBr crystals irradiated at LNT by γ rays. It is found that two hardening stages occur, i.e., two components exist in the hardening curve. The transition from the first to the second stage corresponds to a dose of 2×10^7 R. The former and the latter stages reflect the extrinsic and the intrinsic coloration, respectively. The linear dependence of the induced flow stress on the square root of the F-center concentration and V_4-envelope absorption coefficient is found both in the extrinsic and intrinsic hardenings. The hardening rates with F-center concentration were ≈5.0 and ≈6.2 G, respectively. The recovery of the flow stress accompanied by thermal destruction of the color centers and the thermoluminescence were measured in the temperature range from LNT to 400°K. The recovery is of three stages, the first from 150 to 215°K, the second from 215 to 250°K, and the third stage from 250 to 350°K. Each of these stages involves one intense TL glow peak at least and the characteristic absorption change. Finally, a possible hardening mechanism is discussed in the light of the present experimental results. (9 figures) (auth)

4038 THERMAL CONDUCTIVITY OF DEUTEROMETHANE. Krupskii, I. N.; Koloskova, L. A.; Manzhelii, V. G. (Physical-Technical Inst. of Low Temperatures, Kharkov). J. Low Temp. Phys.; 14: No. 3-4, 403-410(Feb 1974).

Thermal conductivity of solid deuteromethane has been studied in its orientation-disordered phase ($27.1 < T < 89.8$°K). The observed abnormal temperature dependence of the CD_4 thermal conductivity is attributed to the effect of interaction of phonons with correlations of molecular orientations. It is shown that a quantitative description of this abnormal component can be made using the expressions for relaxation times derived by Kawasaki for the case of magnetic crystals. (auth)

4039 STUDIES OF ION CHANNELING AND SURFACE IMPURITIES IN DIAMOND. Sellschop, J. P. F.; Gibson, W. H. (Univ. of the Witwatersrand, Johannesburg). Diamond Res.; 32-39(1973).

The techniques of nuclear physics have been directed in recent years to the study of the interaction of energetic ion beams with matter in single crystal form. Ion channeling methods have been used as a probe in studies of crystal structure and dynamics. Recent results in diamond, which is an excellent crystal for channeling measurements, are presented and discussed. (auth)

4040 NITROGEN DEPENDENT OPTICAL PROPERTIES OF DIAMOND. Davies, G.; Summersgill, I. (King's Coll., London). Diamond Res.; 6-15(1973).

Properties of the two forms of nitrogen in type Ia diamonds have been investigated optically. The measurements are of correlations of infrared, visible, and ultraviolet absorption bands, the annealing of radiation damage, and luminescence quenching. The object was to determine whether the nitrogen impurity is present in the form of platelets or as small clusters, i.e. in very small groups of nitrogen atoms. It is concluded that none of the experiments described make it possible to decide definitely between the two hypotheses. (UK)

4041 VISCOSITY AND NON-IDEALITY COEFFICIENTS OF MoF_6, WF_6, AND UF_6. Determination of the Molecular Parameters. Morizot, P.; Ostorero, J.; Plurien, P. (CEN de Saclay, Gif-sur-Yvette, France). J. Chim. Phys.; 70: No. 11, 1582-1586 (Nov 1973). (In French).

Using a capillary corrosion resisting viscometer, the viscosities of the following gases were measured between 20 and 100 torr: MoF_6, WF_6, UF_6 from 50 to 150°C; binary mixtures UF_6–MoF_6 and UF_6–WF_6 at 81°C. The values of the non-ideality coefficients for the three hexafluorides were obtained between 50 and 200°C by the absolute density method. The results were interpreted using a graphical fitting method and the values of the parameters of the intermolecular Lennard-Jones potential for the hexafluorides MoF_6, WF_6, UF_6 were obtained. The agreement between calculated and experimental viscosities of the binary mixtures UF_6, MoF_6 and UF_6, WF_6 is a validity verification of the parameters (sigma, epsilon). (FR)

4042 DIFFRACTION OF NEUTRONS BY THE LATTICE OF KDP INFLUENCED BY MECHANICAL VIBRATIONS AND BY AN ELECTRICAL FIELD. Sedlakova, L. (Nuclear Physics Inst., Rez, Czech.); Petrzilka, V.; Kawalec, M.; Cech, J.; Michalec, R.; Mikula, P.; Chalupa, B.; Zelenka, J. Phys. Status Solidi (a); 22: No. 2, K223-K225(16 Apr 1974).

Observations are presented of the increase in intensity and modulation of a neutron beam diffracted by the (220) plane of a bar-shaped KDP single crystal at 18°C in its piezoelectric region, as a function of the amplitude of longitudinal bar vibrations in the applied static electric field. (DLC)

4043 PHOTOCONDUCTIVITY OF YTTRIUM IRON GARNET SINGLE CRYSTAL: BULK AND FILM. Suryanarayanan, R.; Krishnan, R. (CNRS, Meudon-Bellevue, France). Phys. Status Solidi (a); 22: No. 2, K177-K180(16 Apr 1974).

The photoconductivity of $Y_3Fe_5O_{12}$ bulk crystals and thin films prepared under different conditions was investigated. The current–voltage characteristics showed ohmic behavior, and the photoconductivity and absorption spectra are given. The photoconductivity and dark current increase with temperature. Activation energies are given. A magnetic field up to 12 kG had no effect. (DLC)

4044 BEAM-INDUCED IMPURITY DISPLACEMENT DURING CHANNELLING MEASUREMENTS ON PHOSPHORUS DIFFUSED SILICON. Allen, C. (Oxford Univ.); Bicknell, R. W.; Newman, R. C.; Peart, R. F.; Stirland, D. J. Phys. Status Solidi (a); 22: No. 2, K171-K175(16 Apr 1974).

Backscattering (2-MeV He ions) and sheet resistivity measurements were made on P-diffused Si. Results indicate that, after irradiation, a significant proportion of the P atoms are in nonsubstitutional lattice positions and that this proportion increases with decreasing concentration and increasing dose. No definitive statements can be made on the identity of the beam-induced defects. It is concluded that the backscattering technique cannot be used to determine the lattice location of either P or As in Si because of damage. (DLC)

4045 RADIOLYSIS AND CRITICAL SCATTERING IN TGS CRYSTALS. Meysner, L.; Pietraszko, A.; Suski, T. (Inst. for Low Temperature and Structure Research, Wroclaw). Phys. Status Solidi (a); 22: No. 2, K157-K161(16 Apr 1974).

The effects of x radiation on the Curie point of TGS crystals were studied using a diffractometer. The Curie point decreases with dose, but the slope becomes smaller with dose. It is concluded that the radioinduced effect must be taken into account in critical diffuse scattering studies of crystals susceptible to radiation damage. (DLC)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 2849 and 3220.

4046 (BARC/I-224) POSSIBLE THREAT OF PLANNED DIVERSIONS. Singh, H. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 39p. INIS.

An attempt is made to show that there exist possibilities for continuous diversion, which are undetected through statistical material accountancy (MA). Diversions considered (1.0, 0.5, and 0.2% of input) are within the limits of measurement errors and biases. Studies of 2400 simulated campaigns are presented. Detailed error propagation, including the effects of input distribution and batch to batch variations on Material Unaccounted For (MUF) is considered. Possible ways for detection of small diversions are introduced based on Cumulative Material Unaccounted For (CMUF). It should be pointed out that detection based on CMUF may not fulfil the requirement of timely detection. (auth)

4047 (ETR-277) VERIFICATION OF REPROCESSING INPUT MEASUREMENTS. Isotopic Correlations on Irradiated Highly Enriched Uranium. Berg, R. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Jan 1973. 23p. INIS.

The irradiation of highly enriched uranium in a reactor is reflected in changes of the weight fractions and the uranium isotopes and in the ratios of the initial and post-irradiation amounts of uranium and its isotopes. Relationships between these parameters were developed and experimentally tested in a reprocessing campaign on more than 500 kgs of highly enriched uranium to establish their value as verification tools. (auth)

4048 (ETR-277) VERIFICATIONS ON REPROCESSING INPUT MEASUREMENTS. The Practical Aspects of Using Lithium-7 Tracing for the Determination of Reprocessing Input Batch Sizes by Isotopic Dilution Mass Spectrometry. Berg, R. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Jan 1973. 29p. INIS.

The fundamental aspects of the ^{7}Li tracing technique on reprocessing input batches have already been established. The investigations made in the practical case on real input solutions are described. A detailed blank study is presented, in which all reagents used in the EUROCHEMIC Reprocessing Plant and its analytical laboratory have been analyzed for their lithium content by flameless atomic absorption. Several tracing experiments on actual input solutions, both from highly enriched uranium and from low enriched uranium campaigns, have been performed. Tracings were also made during calibration runs with demineralized water on two input tanks. The practical possibilities for a quantitative addition of tracer and the related problems are discussed in detail. It was not possible to reach results in agreement with the conventional volume measurement techniques. (auth)

4049 (IAEA-R-990-F) SAFEGUARDING THE INPUT TO A FUEL REPROCESSING PLANT. Final Report, 1 February 1971 – 29 February 1972. Gupta, D. (International Atomic Energy Agency, Vienna (Austria)). Oct 1972. 116p. INIS.

It was recognized at an early date that the input stream to a reprocessing plant would require concentrated attention in the course of developing methods and techniques for safeguards. A fairly large amount of work in this particular field was carried out at the Karlsruhe Research Center in the framework of the safeguards project. The following problem areas were investigated in detail: (a) development of a reliable instrument to indicate the presence or absence of liquid in the pipe lines connected to the input accountability tank in order to detect the bypassing of dissolver solution; (b) investigation of the problems of inhomogeneity and recalibration with the help of tracers; and (c) investigation of the possibilities of tampering and protection of the measurement data system. An inactive experimental set-up consisting of two fully instrumented accountability tanks (one plexiglass, one stainless steel) was used in the investigation to simulate actual commercial scale conditions. Properties of level measuring methods are analyzed for suitable application to detect liquid in piping; an ultrasonic sensor was selected as the most suitable device for detecting the presence of solution in piping; parameters of tracer application are discussed and experiments were carried out using zinc and rhenium; an analysis of three components (generation, transmission and indication) of the information system was performed. (INIS)

4050 (IAEA-R-1014-F) EVALUATION OF OPERATIONAL DATA ON A SWEDISH LOW ENRICHMENT URANIUM FUEL FABRICATION PLANT. Final Report, 1 July 1971 – 31 October 1972. Ekstrand, O. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. vp. INIS.

A safeguards study carried out at the ASEA-ATOM plant is reported. The report covers the period 1968 to 1972 and for each year the available safeguards information is collected and evaluated. The following data are given for the Vaesteras fuel fabrication plant: material balance areas and control measurement points, data on calibration of scales, methods of uranium content determination and enrichment measurement in input UO_2 powder and UO_2 pellets, procedures for preparation and taking of physical inventory and results of inventories, measurement of total uranium and ^{235}U in waste by gamma spectrometry using gamma radiation from ^{234m}Pa, a daughter product of ^{238}U, for uranium content measurements and gamma energy of 185 KeV for ^{235}U measurement, nuclear material accountancy documentation as well as copies of accounting reports and other data related to safeguards. The plant is producing the uranium oxide fuel of low enriched grade. In the inventory list there are uranium materials with the enrichment between 0.22% (depleted) and 10%. In the course of fuel production in 1968, normal operational losses (NOL) for a receipt of 2.69% enriched material were 0.21% of the quantities handled. In 1969 NOL varied in the range of 0.22 to 0.53% for four receipts of material 1.4 to 2.55% enrichment. In 1970 operational losses for enriched material 1.4, 1.7, 2.05, 2.55, 2.90% were 0.74, 0.51, 0.44, 0.64, 0.21%, respectively. Similar figures of the operational losses were received in 1971 and 1972. Uranium balance for manufacturing of OI-reactor fuel for the throughput of 75,415,869 g of uranium MUF value was found equal to 27093 g. (INIS)

4051 (IAEA-R-1099-F) SYSTEMS STUDY ON SAFEGUARDS IN ENRICHMENT PLANTS. Final Report, 1 December 1971 – 30 November 1972. Kiss, I. (International Atomic Energy Agency, Vienna (Austria)). Feb 1973. 156p. INIS.

This is a continuation and expansion of Part I of this report on work carried out during 1969 to 1971 and published as IAEA/STR-14(Rev.1) in October 1972. It examines features of enrichment plants of potential significance for safeguards. Computations are made for ideal cascades covering variations in number of stages, separation factor, number of centrifuges, maximum theoretical enrichment and depletion, magnitude of interstage flow-rates and average isotopic composition of cascade hold-up. The calculations cover a wide range of these parameters showing their interrelationship for selected cascades. The data are presented in the form of tables and graphs suitable for use in safeguards practice. The effect on inspection effectiveness of conducting a proportion of inspections without advance notification is also analyzed mathematically and the possibility of dating the occurrence of isotopic enrichment by analyses of daughter decay products is discussed. A comprehensive literature survey is included consisting of about 500 references classified by subject covering the technical, economic, and political aspects of uranium enrichment. (INIS)

4052 (KFK-1852) ANNUAL REPORT 1972. Bork, G. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Spaltstoffflusskontrolle). Oct 1973. 170p. (In German).

A description of major activities performed in 1972 within the framework of the Nuclear Safeguards Project by the Institutes of Gesellschaft fuer Kernforschung participating in this Project, the European Institute of Transuranium Elements, and some industrial firms such as HRB, INTERATOM, NUKEM, and URANIT is presented. (GE)

4053 NON-DESTRUCTIVE DETERMINATION OF ^{235}U AND THORIUM IN THE SPHERICAL Th–U FUEL ELEMENTS USING PASSIVE GAMMA SPECTROMETRY. Krappel, W. (Technische Univ., Hanover). Atomkernenergie; 23: No. 1, 23-27(1974). (In German).

A gamma-ray spectrometer is described for the relative determination of ^{235}U and thorium of nonirradiated spherical fuel elements of the AVR and THTR high-temperature helium-cooled reactors. Measurements are very insensitive against inhomogeneous distribution of the coated particles. Within a typical analysis time of 30s, the accuracy obtained in the simultaneous and nondestructive determination of the fissile and fertile material is ±1.0%, respectively. (GE)

Disposal and Storage

Refer also to abstracts 2829, 2830, 2833, 2834, 2837, and 3163.

4054 (ARH-SA-175) RETRIEVABLE SURFACE STORAGE FACILITY FOR COMMERCIAL HIGH-LEVEL WASTE. Nelson, D. C.; Wodrich, D. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2130. 16p. (CONF-740428-3). Dep. NTIS $4.00.

From 167th national meeting of the American Chemical Society; Los Angeles, California, USA (1 Apr 1974).

Conceptual design studies for a waste storage facility to store all of the high-level wastes generated by the nuclear power industry through the year 2000 are presented. The facility would be constructed on the surface and would allow the calcined wastes to be retrieved at any time. The design studies include cooled water basins, air-cooled concrete vaults, and air-cooled steel casks. (TFD)

4055 (BNWL-SA-4950) HIGH-LEVEL WASTE FIXATION AND MANAGEMENT. Platt, A. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 19p. (CONF-740319-1). Dep. NTIS $4.00.

From atomic industrial forum topical conference on uranium/fuel cycle 74; New Orleans, Louisiana, USA (17 Mar 1974).

An overview of high-level radioactive management by solidification and storage in a Retrievable Surface Storage Facility is given. (TFD)

4056 (CONF-740428-1) HIGH-LEVEL WASTE MANAGEMENT RESEARCH AND DEVELOPMENT PROGRAM AT OAK RIDGE NATIONAL LABORATORY. Blomeke, J. O.; Bond, W. D. (Oak Ridge National Lab., Tenn. (USA)). 25 Mar 1974. 21p. Dep. NTIS $4.25.

From 167th national meeting of the American Chemical Society; Los Angeles, California, USA (1 Apr 1974).

A review is presented of ORNL work on the feasibility of separating the actinide elements in wastes from the fission products to reduce the long-term risk in disposal. Evaluations of geologic formations other than salt beds for their suitability as disposal media is also discussed. (TFD)

4057 (COO-1680-20) EXCHANGE OF INTERLAYER CATIONS IN MICACEOUS MINERALS. Progress Report, August 1, 1973–July 31, 1974. Scott, A. D. (Iowa State Univ. of Science and Technology, Ames (USA)). 1974. Contract AT(11-1)-1680. 17p. Dep. NTIS $4.00.

The sorption and exchange of cations on interlayer sites of micaceous minerals was studied in terms of six distinct subdivisions: (1) comparisons of Cs sorption by degraded micas in acetone or boiling solutions showed the interlayer cation population can be variable and a factor governing the exchangeability of added Cs. Ways of producing Na-degraded mica with negligible K for controlled Cs sorption experiments were developed; (2) determinations of maximum levels of indigenous Ca, Rb, and K exchange in lepidolite support the idea that these cations occur in a random distribution throughout each interlayer space; (3) a look at interlayer cation exchange with solutions that have a composition comparable to real radioactive wastes was initiated with emphasis on the effects of Al; (4) as much as 80% of the octahedral Fe^{++} in mica was oxidized by Br_2-NaCl solutions, whereas lesser amounts of oxidation occurred when expansion was controlled by K; (5) detailed exchange studies with heated micas identified a retardation effect of heat on dehydroxylated muscovite and correlation with Fe^{++} oxidation in lepidomalane; and (6) the elimination of small particle effects with large mica-solution ratios was re-examined. (auth)

4058 (LA-UR-74-631) STUDIES ON SORTING AND CHARACTERIZATION OF PLUTONIUM PROCESS AND ROOM-GENERATED WASTES. McCurdy, D.; Mulkin, R.; Umbarger, C.; Wheeler, M.; Zerwekh, A. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 20p. (CONF-740406-12). Dep. NTIS $4.00.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Waste characterization of room and process-generated wastes contaminated with plutonium has been an important part of the waste management research and development programs at Los Alamos Scientific Laboratory. Preliminary information on the types of waste matrices and the degree of transuranic contamination from typical operations have been reported. Predicated on the accumulated data obtained thus far, laboratory experiments have been outlined to determine the extent and products of radiolytic degradation of the various waste matrices commonly found. Radiolysis experiments have shown that significant quantities of H_2, CO, and CO_2 can be generated when cellulosics are contaminated with 0.6 to 1.2 mg of heat-source plutonium per gram of substrate. (auth)

4059 (N-74-14533) FEASIBILITY OF SPACE DISPOSAL OF RADIOACTIVE NUCLEAR WASTE. 1. Executive Summary. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Dec 1973. 21p. (NASA-TM-X-2911; E-7679). NTIS $2.75.

This NASA study, performed at the request of the AEC, concludes that transporting radioactive waste (primarily long-lived isotopes) into space is feasible. Tentative solutions are presented for technical problems involving safe packaging. Launch systems (existing and planned), trajectories, potential hazards, and various destinations were evaluated. Solar system escape is possible and would have the advantage of ultimate removal of the radioactive waste from man's environment. Transportation costs would be low (comparable to less than a 5% increase in the cost of electricity) even though more than 100 space shuttle launches per year would be required by the year 2000. (auth)

4060 POSSIBILITIES OF UNDERGROUND SALT CAVITIES AS RADIOACTIVE WASTE REPOSITORIES IN THE NETHERLANDS. Hamstra, J. Atoomenergie Haar Toepass.; 15: No. 12, 290-301(Dec 1973). (In Dutch).

Computations on the extent and nature of storage facilities required for long-lived radioactive waste products are reported, making various (alternative) assumptions about trends in the Netherlands nuclear industry over the next decades. Although certain underground salt cavities could meet the necessary safety criteria (e.g., of high structural and thermal stability), such cavities are likely to be in short supply. Alternative repositories, in the Netherlands or elsewhere, may have to be sought, therefore, if the nuclear power program is not to be seriously impeded. (NL)

4061 RADIOACTIVE WASTE: ITS POSSIBLE APPLICATIONS. Sato, S. (Japan Atomic Energy Research Inst., Takasaki). Kagaku Kogyo; 24: No. 8, 78-84(Aug 1973). (In Japanese).

With the rapid advance of nuclear power generation, the volume of radioactive wastes and hence the amount of useful nuclides produced will increase significantly. The development of techniques for the recovery and utilization of fission products and heavy nuclides is necessary for the efficient utilization of resources and environmental conservation. Salient in this regard are the high-level liquid wastes from fuel reprocessing plants. General matters in this connection are first explained, such as the types of radioactive wastes, the distribution of fission products, the treatment and disposal of radioactive wastes and the economy of waste treatment and disposal in fuel reprocessing plants. The recent development in the utilization of fission products and heavy nuclides and the problems involved are reviewed, i.e., ^{85}Kr, ^{90}Sr, ^{137}Cs, ^{144}Ce and ^{147}Pm as radionuclides, and Tc, Ru, Rh, Pd and Xe as nonradioactive or weakly active nuclides; and some heavier nuclides. (JA)

4062 SUMMARY OF THE STUDY OF DISPOSAL OF NUCLEAR WASTE INTO SPACE. Rom, F. E. (Lewis Research Center, Cleveland). pp 7.19-7.26 of Technology Today and Tomorrow. Cape Canaveral, FL; Canaveral Council of Technical Societies (1973).

From tenth space congress; Cocoa Beach, FL (11 Apr 1973).

NASA, at the request of the AEC, is conducting a preliminary study to determine the feasibility of disposing of nuclear waste material into space. The study has indicated that the Space Shuttle together with expendable and nonexpendable orbital stages such as the Space Tug or Centaur can safely dispose of waste material by ejecting it from the solar system. The safety problems associated with all phases of launching and operation (normal, emergency and accident) of such a system are being examined. From the preliminary study it appears that solutions can be found that should make the risks acceptable when compared to the benefits to be obtained from the disposal of the nuclear waste. (auth)

4063 PROCESS AND APPARATUS FOR THE STORAGE OF NUCLEAR-IRRADIATED FUEL ELEMENTS. Verbeke, R.; Heylen, P. (to Belgonucleaire). US Patent 3,800,857. 2 Apr 1974. Priority Date 22 Jun 1970, Netherlands. 4p.

Fuel elements irradiated in a sodium-cooled nuclear reactor are stored by immersion in individual vessels containing a sodium-containing heat transfer fluid, which vessels are collectively placed in a larger vessel through which an organic heat transfer fluid is circulated. (Official Gazette)

4064 SOME CONSIDERATIONS ON THE PRODUCTION OF RADIOACTIVE WASTES IN ITALY UNTIL THE YEAR 2000.

Branca, G.; Gera, F.; Polvani, C. (CNEN, Rome). Minerva Fisiconucl.; 16: No. 4, 168-176(1972). (In Italian). (RT/BIO-(73)31).

The main factors on which the production of radioactive wastes depend are considered, i.e., increase in the total installed electric power and its fraction of nuclear origin, type of newly designed reactors, policy for the reprocessing of irradiated nuclear fuels, etc. The assumptions that can be made on these elements, some derived from official sources, some introduced by the authors themselves, allow an assessment to be made on the amount of radioactive wastes which could be produced in Italy until the year 2000; the values range from a minimum development hypothesis to a maximum development hypothesis. This assessment on future possible wastes has to be considered in connection with the possibility of a rational and timely planning of the technical, administrative and also political interventions necessary to solve in the best way the problems of the treatment and ultimate disposal of radioactive wastes. (auth)

4065 RADIOACTIVE WASTE MANAGEMENT IN WESTERN EUROPE: PRESENT AND FUTURE. At. Jap.; 17: No. 6, Suppl., 62-72(Jun 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

In western Europe, it is expected that nuclear power generation in the year 2000 will account for some 50% of total power generation. Therein arises the grave problem of proper radioactive waste disposal. The following are described concerning this aspect of the nuclear power generation in Western Europe: general principles of waste management; roles of national and international authorities; present waste management practice; and future outlook. As long as the ICRP recommendations are observed properly, the effect of radioactivity may well be controlled. For the solution for the time being, there are engineered storage structures; but the practices being pursued now have to be discontinued sooner or later, for better means in the future must be found. In this connection, there are two sides of waste management, i.e., those of national and international levels. (JA)

Handling Equipment and Procedures

Refer also to abstract 5550.

4066 (CEA-CONF-2541) ORGANIZATION OF NUCLEAR SAFETY IN A UNIVERSITY ESTABLISHMENT. Kissel, P.; Renard, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). [nd]. 12p. (In French). (CONF-730907-23). Dep. NTIS (U. S. Sales Only) $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

The CEA was asked to furnish technical assistance to a university in matters of nuclear safety. The new problems posed by the establishment of a safety organization using means available were synthesized. The action modalities developed and tested in a large university establishment are defined. (tr-auth)

4067 (ETR-272) BUCK: A FORTRAN-IV CODE FOR THE COMPUTATION OF THE VOLUME AND GEOMETRICAL BUCKLING TO BE USED FOR THE DETERMINATION OF THE "SAFE CRITICAL" CONCENTRATIONS OF FISSILE MATERIALS CONTAINED IN VESSELS WHICH ARE NOT GEOMETRICALLY SAFE. Challe, J.; Hagsgard, S. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). May 1971. 8p. INIS.

The determination of the safe concentration of fissile material contained in vessels which are not geometrically safe is a time-consuming problem which arises frequently in nuclear reprocessing plants. This program was therefore elaborated in order to speed up the computations involved. It outputs the volume and the geometrical buckling of the solution contained in any standard-shaped vessel, for as many as 30 different values of the level. It is written in Fortran IV and is run on a PDP8-I, equipped with an 8K core memory. (auth)

4068 (LA-UR-74-591) DEMOLITION OF BUILDING 12, AN OLD PLUTONIUM FILTER FACILITY. Christensen, E. L.; Garde, R.; Valentine, A. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 75p. (CONF-740406-9). Dep. NTIS $6.75.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

The decommissioning and disposal of a plutonium contaminated filter facility at Los Alamos, along with the health physics, waste management, and environmental aspects of the demolition, are described. The filter system had provided ventilation for the main plutonium processing plant at Los Alamos from 1945 until 1973. (auth)

4069 EQUIPMENT AND METHOD FOR THE LOADING OF NUCLEAR FUEL IN A CONTAINER. Jones, C. R. (to Transfer Systems, Inc.). German(FRG) Patent 2,251,380. 26 Apr 1973. 23p. (In German).

A loading plant is described which extends over two levels that are connected to each other over a vertical pit. The lower level below the pit is the uptake section for the transport vessel which can take up a transport vehicle and contains a means of manipulating the vessel (e.g., horizontal placement of the vessel on the vehicle). The lower open end of the pit can be water-proof sealed to the upper open end of the transport vessel. The corresponding sealing elements are presented. The upper level is determined by a liquid filled tank. (GE)

4070 DISMANTLING OF HOT FUEL ASSEMBLIES OF FAST BREEDER REACTORS, WITH PARTICULAR REFERENCE TO COOLING PROBLEMS. Removille, J. (Commission of the European Communities, Luxembourg). Kerntechnik; 16: No. 2, 82-86 (Feb 1974). (In German and English).

Luxatom has studied the problem of dismantling of fast breeder reactor fuel assemblies, using various types of cooling media. Cooling with sodium would be advantageous in the early stages of commercial use of these reactors because it would make it possible to reduce the required cooling time (from 6 months to 1 month) and thus to reduce the immobilization of plutonium. Cooling with gas, with forced circulation, is sufficient for the handling of fuel assemblies of the prototype reactor SNR-300. Practical solutions of problems related to the posting and gas-cooling of fuel assemblies, as well as an inexpensive and fast method of channel stripping are described. (GE)

4071 MINIMUM CRITICAL MASSES OF ARRAYS OF FISSILE OXIDE AND METAL ELEMENTS IN WATER. Hunt, D. C.; Schuske, C. L. (Dow Chemical Co., Golden, CO). Contract AT(29-1)-1106. Nucl. Technol.; 22: No. 2, 263-274(May 1974).

Minimum critical masses are calculated for arrays of fissile metal and oxide rods or metal plates spaced in water. The composition of the fissile materials investigated were 96% ^{239}Pu and 4% ^{240}Pu or 93.4% ^{235}U and 6.6% ^{238}U. In addition, minimum critical masses were computed for arrays of plutonium and uranium metal cubes spaced in water. These studies were made to aid the criticality engineer in evaluating fabrication and storage problems involving the handling of various fissile shapes in hydrogenous media. Results were calculated in terms of array minimum critical masses as a function of the volume-to-surface ratio (V/S) of an array element. The minimum critical mass for cube arrays was found to remain constant over a wide range of V/S values, while the minimum critical mass of plate arrays always decreased with decreasing V/S rod arrays exhibited an intermediate behavior. Oxide arrays generally had smaller critical masses than corresponding metal arrays because of their smaller self-shielding factors. (auth)

Transportation

4072 SPENT NUCLEAR FUEL TRANSPORT: AN INTEGRAL COMPONENT OF REPROCESSING SERVICES. Reprocess. Newslett.; No. 2, 2-3(Dec 1973).

Shipment of spent nuclear fuel may be regarded as the most important additional service directly related to reprocessing. The transport of the irradiated fuel assemblies represents the link between two fixed plants of a very different nature and different working programs. In principle, such transport can be arranged under the responsibility of either party, the reactor operator or the reprocessor, but the experience gained during recent years has clearly demonstrated that there is a strong incentive for both parties to include the transport of irradiated fuel in the reprocessing contract, thus defining the nuclear power plant as the point of delivery of irradiated fuel assemblies and passing the responsibility for their transport to the reprocessor. (GE)

4073 TRANSPORT OF NUCLEAR FUEL SUBSTANCES IN JAPAN. At. Jap.; 17: No. 7, 25-27(Jul 1973).

Rules and regulations, respective kinds of land transport, and marine and air transport of nuclear fuel materials in Japan are summarized. Rules and regulations for transport of radioactive materials by road vehicles cover: methods for packaging nuclear fuel materials for transport, how to load in the vehicle, and rules

to be observed during transport etc. The rules place a limit on the weight of a radioactive package. If a nuclear fuel substance is contained in a package and exceeds 2.7 Ci per package, approval for the transport must be obtained from the Minister of Transport. As for marine transportation, the regulations on carriage and stowage of dangerous goods in ships sets forth rules governing the packing and stowing of dangerous cargoes. Basic rules for air transport are prescribed by the Civil Aeronautic Law and more detailed rules and regulations are under the "Notice Concerning Rules and Regulations for Transportation of Explosives by Airplanes." Containers for the carriage of nuclear fuel materials in Japan are controlled in some ways, by Japan's Atomic Energy Commission (JAEC). Along with the 1972 revision of International Atomic Energy Agency "Rules for Safe Transport of Radioactive Substance" revision work on Japan's for safety inspection is underway. (JA)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 4110.

4074 (JAERI-1228, pp 127-130) POWER-UP OF THE ELECTRON LINAC AT RESEARCH REACTOR INSTITUTE OF KYOTO UNIVERSITY AND PLANS FOR NEUTRON CROSS SECTION MEASUREMENTS. Fujita, Y. (Kyoto Univ.). Jul 1973. (In Japanese).

The recent status of the electron linear accelerator facility at Research Reactor Institute of Kyoto University is reported. It is an L-band machine and was upgraded to 46 MeV in maximum energy and 10 kW in average beam power in 1971–72. Plans for neutron cross section measurements of Pd, Ho and Ce in the keV region using 20–50 m flight paths are also reported. Lithium-6 glass scintillators and total energy detectors of NE-226 are used for transmission and capture measurements, respectively. (auth)

4075 (JAERI-M-5388) TREATMENT OF OZONE AND NITROGEN OXIDES PRODUCED IN OPERATION OF HIGH DOSE RATE ELECTRON ACCELERATOR. Sugiura, T.; Nakai, Y.; Takagaki, T.; Gotoda, M.; Kamiyama, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 64p. (In Japanese). NTIS (US Sales Only).

A high dose rate electron accelerator (25 mA, 800 kV) is to be set up in the Osaka Laboratory in 1973. Ozone and nitrogen oxides are produced in the operation of this accelerator as a result of radiolysis of the air. Treating these gases is necessary to prevent environmental pollution. A working group was formed to investigate this problem. Activities of this working group are described, including the presumption of quantities of the ozone and nitrogen oxides, the inquisition concerned with these gases, the comparison in efficiency between various methods to treat the ozone and nitrogen dioxide, and a description of the disposal device finally designed. In the course of the experiment, it was found that the adsorption and the decomposition of the ozone and nitrogen dioxide in active carbon are effective and also low in cost, however, ozone-adsorped-active carbon has danger of a deflagration or detonation. It was found that a fine-powdered active carbon dispersed with about 20% by weight of silica-alumina gel (Sekado) is an efficient material to treat the ozone and nitrogen dioxide without any danger, and this material was adopted as the disposal material. (auth)

4076 (RISO-M-1690) ACCELERATOR DEPARTMENT ANNUAL PROGRESS REPORT, JANUARY 1, 1973–DECEMBER 31, 1973. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

After a brief summary of general information and events of the year, the various activities are described: these include operation and maintenance of the irradiation facilities, radiation bacteriology research, chemical dosimetry and radiation chemistry, physical dosimetry, and irradiation technology. Appendices list the staff, irradiation facilities available, and publications and lectures. (RWR)

4077 AUTORESONANT ACCELERATOR CONCEPT. Sloan, M.L.; Drummond, W.E. (Austin Research Associates, Inc., Austin, Texas 78705). Phys. Rev. Lett. 31: No. 20, 1234-1238 (12 Nov 1973).

We present a new ion accelerator idea which combines the basic concepts of traveling wave and collective acceleration. The lower cyclotron mode of a relativistic electron beam along a spatially decreasing magnetic field B constitutes the traveling wave, the wave phase velocity varying inversely with B. The negative energy character of the wave allows automatic extraction of energy from the electron beam for the acceleration process. Typical ion energy versus current outputs are estimated. (auth)

4078 PHASE FREE ACCELERATION OF CHARGED PARTICLES BY AC FIELDS USING DEFLECTING COILS AND TRIANGULAR SHAPED HOLLOW ELECTRODES. Schott, W.; Winter, H. J.; Hagn, H.; Springer, K.; Daniel, H. (Technische Univ., Munich). Nucl. Instrum. Methods; 116: No. 3, 599-601(1974).

Acceleration of charged particles without phase relation between the accelerating ac field and the incoming particles has been established experimentally. A maximum energy gain of 140 eV was obtained for electrons of 20 keV energy. (auth)

4079 COMPACT PULSED ELECTRON ACCELERATOR WITH AN INDEPENDENT POWER SUPPLY. Afonin, Yu. V.; Ponomarenko, A. G.; Soloukhin, R. I.; Khapov, Yu. I. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1310-1312(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 20-22(1973).

A compact pulsed electron accelerator having an independent power supply from a 12 V storage battery is described. The accelerating voltage of ≈240 kV is formed by a pulse-voltage generator with a capacitive energy-storage device. The beam current is 4 kA. The length of a pulse is ≈15 nsec. (auth)

Auxiliaries and Components

Refer also to abstract 5235.

4080 (CONF-720724-P2, pp 201-206) USE OF PLASTIC DETECTORS TO CONFIRM THE ACCELERATION OF ARGON NUCLEI TO RELATIVISTIC VELOCITIES AT THE PRINCETON PARTICLE ACCELERATOR. Filz, R. C. (Air Force Cambridge Research Labs., Bedford, MA); McNulty, P. J.; Davis, A. F. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Argon ions have recently been accelerated to 11.7 GeV at the Princeton Particle Accelerator. This represents a two-fold increase in the mass over particles previously accelerated to relativistic energies. A stack of cellulose nitrate track detectors used to confirm the successful acceleration with the unambiguous identification of 79 argon tracks within a clearly defined 1¼ inch beam spot is described. (auth)

4081 (JINR-P13-7154, pp 101-108) PROFILE METER FOR A LOW-INTENSITY CHARGED PARTICLE BEAM. Damaskinskii, E. A.; Kashuk, A. P.; Prokof'ev, O. E.; Samsonenkov, V. S. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

A self-contained device permitting the continuous measurement of the distribution of the charged particle intensity across the beam was designed and constructed. The detector consists of a multiwire proportional chamber. The design and typical results obtained in use on the synchrocyclotron beam are reported. (JSR)

4082 (JINR-P13-7154, pp 109-112) SYSTEM FOR THE MEASUREMENT OF THE PROFILES OF LOW-INTENSITY CHARGED PARTICLE BEAMS. Damaskinskii, E. A.; Kashuk, A. P.; Krivshich, A. G.; Prokof'ev, O. E.; Samsonenkov, V. S. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

A system was developed for the measurement of the profile of the synchrocyclotron beam. It consists of a multiwire proportional chamber, a multichannel analog storage element, and a control console. Its output is fed to the computer through a coding device, and its functional circuit is given. Each operational regime of the device is briefly illustrated. (JSR)

4083 (JINR-P13-7154, pp 150-162) BEAM DIAGNOSIS SYSTEM USING THE ANALOG METHOD WITH PROPORTIONAL CHAMBERS. Zanevskii, Yu. V.; Ivanov, A. B.; Mikhailova, M. N.; Peshekhonov, V. D.; Filatova, N. A.; Chernenko, S. P.; Shirokov, B. S. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data on the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

A system for beam diagnosis was developed based on the use of the analog method and a proportional chamber. A functional diagram is given of the diagnostic system. The characteristics of the proportional chamber used are reported. The circuit for signal recording is given, and results of experimental testing of the system are reported. (JSR)

4084 (JINR-P13-7154, pp 163-171) DETERMINATION OF THE THREE-DIMENSION PROFILE OF A BEAM OF ACCELERATED PARTICLES BY MEASUREMENT OF THE IONIZATION CURRENT. Vishnyakov, V. V.; Zhuravlev, N. I.; Komarov, V. I.; Kosarev, G. E.; Nguen Man Shat; Sinaev, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

An array of proportional counters or chambers whose gas amplification can be reduced to 10^7 was used for the determina-

tion of very intense beams. The maximum intensity of the beam is not limited and is determined by the size of the charge capacitance and by the time of the charge accumulation. The principal circuit of the linear part of the installation and a block diagram of the complete system are given. Typical results are given for illustration. (JSR)

4085 BETATRON. Chakhlov, V. L.; Zvontsov, A. A.; Filimonov, A. A. (to Tomsky Ordena Trudovogo Krasnogo Znament Politekhnichesky Institut). British Patent 1,341,330. 19 Dec 1973. Filed Date 20 Jun 1972. 5p.

Reference is made to electromagnets used in betatrons. In earlier betatron electromagnets the pole-piece steel is not fully loaded due to nonuniform distribution of the magnetic flux in the air-gap zone. This is because magnetic induction reaches saturation level (about 15,000 gauss) in the flat central part of the pole-piece, whereas in the vicinity of the equilibrium orbit, with the betatron ratio (2:1) maintained, the magnetic induction is only about 3,000 to 5,000 gauss. Considerable magnetic leakage from the end faces of the pole-pieces also reduces the efficiency of the installation, and gives rise to increased dimensions and weight. The electromagnet described has pole-pieces with a solid central portion and at least three spokes projecting radially from the central portion to a point within the operating region. Two pole-pieces are preferably provided, with the ribs of one pole-piece facing corresponding ribs of the other pole-piece. The spoke surfaces facing the operating region may be concave, and the ribs of one pole-piece may be angularly displaced relative to the ribs of the other about an axis common to both pole-pieces. (UK)

4086 SOME PROBLEMS ARISING IN THE OPTIMIZATION OF A PROCESS BY COMPUTER AND THEIR SOLUTION. Daneels, M. A. (CERN, Geneva). Neue Tech.; 15: No. 9, 343-351 (Sep 1973). (In French).

A strategy is suggested for the computer optimization of a process for which no mathematical model is known. As an example, the control of the CERN proton synchrotron is discussed, and the results analyzed. (INIS)

4087 MEASUREMENT OF A HIGH VOLTAGE BY A ROTOR VOLTMETER USING AN INSULATED ELECTRODE. Novikov, M. T. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1591-1592(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 247-248(1973).

The possibility and singularities of the measurement of a high voltage (such as in electrostatic accelerators) by a rotor voltmeter when the electric field from the high-voltage electrode is brought out to the voltmeter by means of an insulated measurement electrode are demonstrated experimentally. The measurements were carried out at voltages of 0 to 50 kV. (auth)

4088 A SIMPLE "CAMERA" FOR HIGH ENERGY BEAMS. Longo, M.J.; Haas, O.E. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Rev. Sci. Instrum. 45: No. 3, 456-456 (Mar 1974).

By incorporating an x-ray intensifying screen into a standard 10×12.7 cm Polaroid film back, we have been able to reduce the exposure time required to obtain a beam profile drastically. The modified film backs have been used very successfully in high-energy neutron and charged particle beams. (auth)

4089 SUPPRESSION OF ODD HARMONIC COMPONENTS IN A CYCLOTRON BEAM PICK-UP SIGNAL BY MEANS OF SAMPLING. Marchand, J.F.P.; Schutte, F.; Hagedoorn, H.L. (Eindhoven University of Technology, Department of Physical Engineering, Cyclotron Laboratory, Eindhoven, The Netherlands). Rev. Sci. Instrum. 45: No. 3, 361-363 (Mar 1974).

The current and the phase angle of the internal beam with respect to the accelerating voltage of the Eindhoven University of Technology AVF cyclotron are measured using a number of electrostatic induction pick-up probes. Data handling is by means of sampling, correlating, and a CAMAC system. On the hf signal is superimposed a very strong first (fundamental) harmonic signal induced by the accelerating voltage. Therefore, the second harmonic component of the probe signal is used. Furthermore, all odd harmonic components of the signal are suppressed by using a special sampling technique. For the first harmonic component the suppression is about 60 dB. (auth)

4090 NEW DESIGN FOR ACCELERATING STRUCTURES. Tran, D. T. (Domaine de Corbeille, Orsay, France). Nucl. Instrum. Methods; 116: No. 3, 597-598(1974).

A low-cost and efficient design for an electron and proton accelerating structure is described. (auth)

4091 SIMPLE SPECTRUM MONITOR FOR E × B VELOCITY FILTERS. Ryssel, H.; Mueller, H.; Schmid, K. (Technische Univ., Munich). Nucl. Instrum. Methods; 116: No. 3, 593-595 (1974).

A simple spectrum monitor for E × B filters in ion implantation systems is described. It permits a dynamic control of ion-optical parameters such as focus and extraction voltage and proves to be beneficial in optimizing the machine performance by improved control of gas flow and beam qualities. The spectrum monitor is realized by modulating the electric field of the E × B filter by means of a transformer and displaying the ion current at the target vs the modulating voltage. (auth)

4092 MEASUREMENTS ON HALF-WAVELENGTH HELIX RESONATORS. Bendt, P. J.; Erkkila, B. H.; Stokes, R. H. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 116: No. 3, 555-559(1974).

Dimensions and performance of a number of half-wavelength 50 MHz cylindrical helix resonators are reported. The phase velocities are between 0.023 and 0.102 of the velocity of light, and the shunt impedances vary between 13 and 31 MΩ/m. The effect of end-spacing and other resonator dimensions on the shunt impedance has been measured. The shunt impedance measurements are compared with sheath-model theory. Two prototype linac resonators have been tested at rf power levels up to 16 kW, which produced axial accelerating fields up to 1 MV/m. It was learned that helix resonators cannot be operated stably without some form of feedback frequency control, due to electromagnetically driven mechanical oscillations in the frequency range 110 to 150 Hz. (auth)

4093 STABILIZING THE BEAM CURRENT FROM THE HAMBURG ISOCHRONOUS CYCLOTRON WITH A CONTROL ELECTRODE IN THE ION SOURCE OUTLET. Krause, H.; Langkau, R. (Univ., Hamburg). Nucl. Instrum. Methods; 116: No. 3, 603-604(1974). (In German).

A method for stabilizing the beam current from a cyclotron by an ion source bias is described. (auth)

4094 METHOD AND MEANS OF EFFECTING CHARGE EXCHANGE IN PARTICLE BEAMS. Yntema, J. L. (to United States Atomic Energy Commission). US Patent 3,806,749. 23 Apr 1974. Filed Date 12 Jan 1973. 6p.

The usable lifetime of carbon stripping foils used to effect charge exchange in particle beams is extended by depositing a thin electrically conducting layer on the foil, mounting the foil on a holder selected to control thermal expansion, and heating the foil before and during the time it is used for stripping. (Official Gazette)

4095 OPERATING FEATURES OF AN AUTOMATIC SYSTEM REGULATING THE AMPLITUDE OF AN ACCELERATING FIELD IN A LONG RESONATOR OF A LINEAR PROTON ACCELERATOR. Kvasha, A. I.; Murin, B. P. Tr. Radiotekh. Inst.; No. 9, 65-74 (1972). (In Russian).

The operation of a fast-acting system is considered for automatically regulating the amplitude of an accelerating field in the presence of higher types of oscillations (modes) in the resonator. Particular attention is devoted to studying the effect of oscillations closest to the basic type—of the first mode. Data are presented on tests of the automatic regulation system with a shunting tube on the I-100 accelerator, the injector of the Serpukhov synchrotron, which confirms the results of the analysis. A method is considered for suppressing beats between the first and primary modes at the feedback circuit entry of the automatic regulation system. (SJR)

4096 INVESTIGATION INTO THE LINER STABILIZER FOR THE OXFORD INJECTOR. Takacs, J. (Nuclear Physics Lab., Oxford). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 4, 3-11(Aug 1973).

A mathematical analysis is presented of a combined liner and spray charge control system for regulating the voltage of the single ended Van de Graaff which forms the injector of the Oxford coupled Electrostatic Generators. The stabilizer design, based on this analysis, incorporates automatic switch-over to an auxiliary generating voltmeter stabilizer loop. An automatic gain control in the slit amplifiers eliminates the necessity for manual gain adjustments in most operating conditions. The voltage stability achieved in operation gave a beam energy stability of ±7 parts in 10^5 i.e., 4.447 ± 0.000325 MeV measured using the resonance in the reaction $^{15}N(\alpha,\gamma)^{19}F$. Repeated voltage breakdowns of the HT terminal were prevented by a protection circuit based on the analysis of the breakdown behaviour of the generator. The calculated performance of the circuit has been verified by the observed behaviour after total breakdown. (auth)

4097 IMPROVING THE RELIABILITY OF CYCLOTRON OPERATION. Nikitin, A. A.; Nurbaev, A. S.; Uzakov, Ya. M.

(Inst. of Nuclear Physics, Ulugbek, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1313-1314(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 22-23(1973).

In order to increase the operating reliability of the power supplies of a U-150-P cyclotron, contactless controllers based on magnetic amplifiers are used. (auth)

4098 DETERMINATION OF THE PARAMETERS OF THE MICROWAVE PATH WHICH WILL ENSURE STABLE OPERATION OF A MICROTRON. Zhulinskii, S. F.; Mirzoyan, A. R. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1315-1317(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 24-25(1973).

Based on numerical calculations and experimental investigations, practical recommendations are given on the choice of the parameters of a microwave path which ensure stable operation of the microtron. (auth)

Ion Sources and Injection and Extraction Systems

4099 (BARC/I-225) CROSSOVER TECHNIQUE AND OTHER METHODS FOR THE CALIBRATION OF THE CYCLOTRON BEAM ENERGY. Srivastava, D. K.; Ganguly, N. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 17p. INIS.

Various energy calibration techniques for cyclotrons such as (1) the time-of-flight technique, (2) calibration technique of Kenefick et al, (3) the cross-over technique, and (4) methods based on kinematics are described and discussed. The absolute accuracy of the energy measurement depends on the accuracy with which the crossover angle is determined and the uncertainty in the excited energy state. The need for relativistic calculations and corrections as the energy increases is pointed out. A method for determining the crossover technique with a slight modification is used to calibrate the beam analyzer-magnetic spectrograph combination and subsequently used for the calibration of beam energy. Tables are presented listing the crossover angles for elastic-inelastic and inelastic-inelastic crossover using ^{12}C, ^{16}O, ^{6}Li as targets and p, d and α as projectiles. (INIS)

4100 (BNL-tr-560) MEASUREMENT OF THE PROTON SYNCHROTRON SLOW-EXTRACTION EFFICIENCY. Grozdev, V. Ya.; Zaitsev, L. N.; Issinskii, I. B.; Kryachko, A. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. Translated by S. J. Amoretty from Russian. 9p. Dep. NTIS $3.00.

A method for measuring the extraction efficiency of a synchrotron based on measuring the number of particles remaining in the chamber after extraction and estimating the particles lost by scattering in the extraction system is described. Measurements were performed on the JINR synchrotron to verify the method. (WHK)

Ion Optics and Field Calculations

4101 (LBL-2414) EIGENVALUES AND EIGENFUNCTIONS FOR LINEAR ACCELERATOR (ALVAREZ) CAVITIES BY THE MATRIX METHOD USING MODIFIED CUBIC SPLINE APPROXIMATION. Young, J. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

We approximate (lesser positive) eigenvalues and corresponding eigenfunctions for the partial differential equation and boundary conditions pertinent to the electromagnetic field for a linear accelerator cavity. We assume azimuthal independance. Symmetry requirements enable us to confine our computation to one-quarter of the cavity. We use a rectilinear grid on the domain of solution and along any grid line the eigenfunction is assumed (with certain exceptions) to be a cubic spline in the pertinent variable with knots at the meshpoints. The requirement that this spline satisfy the differential equation at the mesh-points leads to a linear system in which the (unknown) eigenvalue appears. Finally, the differential eigenvalues are approximated by eigenvalues of a matrix derived from the linear system. For any such real positive distinct eigenvalue, a corresponding approximate eigenfunction is obtained by finding a (nonzero) solution to the system. Several eigenvalues (having least values) may be approximated and corresponding eigenfunctions obtained. The advantages of the "matrix" method, described, over optimization techniques (minimization of a Rayleigh quotient) are that: (1) several lower value eigenvalues are obtained rather than just the least; and (2) extensive iteration is not required. The advantages of using a cubic spline formulation rather than finite difference formulas are that: (1) the approximation to the eigenfunction is a (cubic spline) function rather than a set of approximate solution values at meshpoints; and (2) processes of differentiation (up to second order), integration and interpolation can be more easily applied. (auth)

4102 (NP-19989) CALCULATION OF MAGNETIC CHARACTERISTICS OF THE RING UNIT OF THE INSTITUTE OF HIGH ENERGY PHYSICS ACCELERATOR BY THE IRREGULAR TRIANGULAR MESH METHOD. Puzynovich, Yu. T. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The main magnetic characteristics of the proton synchrotron ring unit at the Institute of High Energy Physics (IHEP) are determined by a precision computation method. The detailed results of the calculations are presented and are compared with the experimental data and computed results of other authors. The method and peculiarities of computer program are briefly described. (auth)

4103 RANDOM PERTURBATIONS IN THE TRANSVERSE MOVEMENT OF PROTONS IN LINEAR, HIGH-ENERGY ACCELERATORS. Bondarev, B. I.; Durkin, A. P.; Solov'ev, L. Yu. Tr. Radiotekh. Inst.; No. 9, 3-22(1972). (In Russian).

A new method is presented for calculating the effect of random perturbations of focusing parameters on the cross-sectional dimensions of the beam in linear proton accelerators. By studying the four-dimensional phase volume it was possible to estimate the radius and emittance of the bundle without any substantial limitations on the magnitude of the random perturbations. Probability modeling on a computer was used along with analytical methods. (SJR)

4104 PULSED MAGNETIC QUADRUPOLE LENS WITHOUT SALIENT POLES. Skachkov, S. V. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1326-1328(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 31-33(1973).

A quadrupole magnetic lens which produces a gradient of 300 G/cm in a pulse for an aperture 11 cm in diameter is described. The magnetic core, which is glued together from rings made of E320 steel, consists of a hollow cylinder having no poles. A theory of such lenses and the computation formulas that take into account the thickness of the layer winding are presented. (auth)

4105 BETATRON OSCILLATION FREQUENCIES AT EREVAN SYNCHROTRON. Esin, S. K.; Nikogosyan, V. Ts.; Tumanyan, A. R. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 3, 213-219(1973). (In Russian).

The calculated values of betatron oscillation frequencies in the 6 GeV electron synchrotron are given. The dependence of the frequencies on different parameters and regime of operation of the synchrotron were measured. The method of measurement was a resonance destruction of the accelerated beam by means of an rf magnetic field. (auth)

Storage Rings

Refer also to abstract 3404.

4106 (BNL-18820) ISABELLE ANTIPROTON OPTION. Baltay, C. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 3p. (CONF-740522-1). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The possibility of colliding antiprotons in ISABELLE has been investigated. Protons are accelerated on the second harmonic to 200 GeV in one of the rings and are extracted into a bypass during flat top. The 30 GeV antiprotons from a target placed at a low-β point in this bypass are transported to the second ring where they are injected and matched into a bucket of a 10th harmonic rf system. This procedure is repeated until all the buckets are filled. The antiprotons are then accelerated to 200 GeV. Protons are now stacked in the first ring in the opposite direction, accelerated to 200 GeV and made to collide with the antiprotons. p-$\bar{p}$ luminosities up to ~10^{29} cm^{-2} sec^{-1} seem feasible. (auth)

4107 (IAE-2234) SYSTEM OF TRANSMISSION, ACCUMULATION, AND TREATMENT OF DATA FROM DETECTORS SEP-

ARATE FROM THE MEASUREMENT AND CALCULATION CENTERS. Vinogradov, A. A.; Kurakin, A. L.; Kurashov, A. A. (Gosudarstvenny} Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1972. 12p. (In Russian). INIS.

A system is considered for the transmission and accumulation of information obtained in experiments on electrostatic accelerators or in a measuring center at a distance of 0.5 km. Results are shown on studies of a connecting line to transmit the data in analog form. In the measuring center the information is accepted by an AI-2048 analyzer which through a multichannel connecting line is tied into a computer TsVM-220 operating in an interrupt mode. (tr-auth)

4108 (JINR-P13-7154, pp 70-73) SYSTEM FOR THE MEASUREMENT OF THE LUMINOSITY ACCORDING TO THE SINGLE AND DOUBLE BREMSSTRAHLUNG. Krupin, N. I.; Solodov, E. P. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From data of the working committee on the methodics of proportional chambers; Dubna, USSR (27 Mar 1973).

The system, incorporating a wire proportional chamber, for the measurement of the luminosity at the VEPP-2 storage ring under construction at the Institute of Nuclear Physics is briefly described. The luminosity can be measured with a precision of ~5%. (JSR)

Experimental Facilities

Refer also to abstracts 3257, 3315, 3336, 3389, 3402, 3549, 4561, and 5046.

4109 (FRNC-TH-480) DEVICE FOR THE ACQUISITION AND PRE-PROCESSING OF MULTIPARAMETER DATA. Pranal, Y. (Paris-11 Univ., 91 – Orsay (France)). 1973. 92p. (In French). Dep. NTIS (US Sales Only) $7.75.

Thesis.

An automatic sequential programmed system was developed to process data from nuclear experiments conducted with the 60 MeV Saclay linear accelerator. The system was used to study the γ spectra emitted in Au resonances following radiative neutron capture. An interface for processing the work carried out was added to the system. The absence of such an interface renders the system sensitive to all the task accomplishment signals from associated equipments (even if they are not incorporated into the program). When the interface is used, only signals from controlled equipment are effective. Such an arrangement enables all the different equipment to be used manually and independently of the operating program and leads to a high operational reliability. The free choice of the type of indexing used combined with an interface to process the different runs gives the system the versatility of a small computer performing the same tasks. The low pre-processing cost associated with the use of this system ensures its future for multiparametric experiments. (FR)

4110 (JAERI-1228, pp 117-126) NEUTRON CAPTURE MEASUREMENTS AT THE JAERI LINAC. Mizumoto, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. (In Japanese).

The construction of the new JAERI Linac was completed in April 1972, and the experiments on the neutron cross-section measurements were started in September 1972. A brief description of the new Linac and the experimental program is presented. (auth)

4111 (LA-tr-74-9) 1972 ACTIVITY REPORT. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). 1974. Translated from pp 69a; 70; 71-73; 75-107; 110-114; 117; 138-161; 164-189 of Tatigkeitsbericht, 1972. 139p. Dep. NTIS $10.00.

Selected portions of the German-language 1972 Activity Report of the Swiss Institute for Nuclear Research were translated into English. Although all of the embedded section headings and numbers are of course included, lack of any table of contents makes use of the document difficult. (RWR)

4112 PRODUCTION OF ^{10}BeO TARGETS VIA THE ^{13}C(n, α)^{10}Be REACTIONS. Goosman, D. R. (Brookhaven, National Lab., Upton, NY). Nucl. Instrum. Methods; 116: No. 3, 445-449(1974).

Pyrolytic graphite enriched to 90% in ^{13}C has been irradiated with fast neutrons to make beryllium enriched to 94% in ^{10}Be. The technical aspects of this process and the fabrication of ^{10}Be into thin BeO targets for use in nuclear spectroscopy is described. (auth)

4113 TAGGED GAMMA-RAY BEAM FOR THE CALIBRATION OF INSTRUMENTS FOR GAMMA-RAY ASTRONOMY. Christ, H. (DESY, Hamburg); Peters, F.; Bignami, G. F.; Burger, J. J.; Hermsen, W.; Paul, J. A.; Pfeffermann, E.; Taylor, B. G.; Voges, W. H.; Wills, R. D. Nucl. Instrum. Methods; 116: No. 3, 477-485(1974).

For the calibration of detectors used in gamma-ray astronomy a beam of tagged photons in the appropriate energy range has been found to be an essential requirement. Such a beam covering the energy range from 20 MeV to 6 GeV has been set up at DESY, initially for the calibration of the payload of the COS-B satellite. The layout of the beam elements and associated electronics is described and the choice of design parameters is discussed. It is shown that the beam meets the requirements of the application in respect to energy range and definition, intensity, collimation and background contamination. (auth)

4114 THIN METAL WINDOWS FOR GAS TARGETS. Jarmie, N.; Morrison, L. J.; Martin, J. C. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 116: No. 3, 451-452(1974).

Experience with thin metal foils as windows for hydrogen gas targets that are irradiated by particle beams, indicates that molybdenum is often the metal of choice. Where a high-Z material is needed for low-background neutron production, a new alloy of 75%Pt-25%Ir appears to be useful. Experience with Havar and tantalum foils is also reported. (auth)

4115 HIGHLY VISIBLE HELIUM TARGET FOR MEDIUM ENERGY PHYSICS. Vincent, J. S.; Smith, W. R. (Lewis Research Center, Cleveland). Nucl. Instrum. Methods; 116: No. 3, 551-554(1974).

Good refrigeration of an extended-area liquid ^{3}He or ^{4}He target has been accomplished by surrounding the primary target volume with a thin sheet of superfluid. (auth)

4116 MEDICAL CYCLOTRON AT THE INSTITUTE OF MEDICAL SCIENCE, UNIVERSITY OF TOKYO. Watanabe, N. (Tokyo Univ.). Tokyo Igaku; 80: No. 2, 103-113(Sep 1972). (In Japanese).

The construction plans of the small CS-30 type cyclotron to be set up at the Institute of Medical Science, University of Tokyo are outlined, particularly for the treatment of malignant tumors with fast neutron beams. The historical background of fast neutron therapy is described. Models of cyclotrons were selected in consideration of dose rate and depth dose as physical conditions, RBE and OER as radiobiological conditions, economical factors, problems of targets, and clinical conditions. The establishment of the treatment room, installation of the beam collimator, design of safe thick wall, analysis of therapeutic methods and results, and the problem of securing necessary personnel are mentioned. In addition, problems of neutron therapy are discussed with regard to the relationship between the single radiation dose required for obtaining useful gain and the transition region dose, number and method of fractionation, total dose, and biological radiation effects on the normal tissues. (JA)

4117 DEVICE FOR AUTOMATIC ALIGNMENT OF TARGETS. Khalin, N. F.; Gologny a, V. Ya.; Khvastunov, V. M.; Shevchenko, N. G. (Physiotechnical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1323-1325(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 29-31(1973).

The construction of a device with automatic rotation of the plane of changeable targets relative to the beam of accelerated particles and the magnetic recording spectrometer is described. The device allows the systematic errors that arise in performing comparative measurements to be reduced and accelerates the performance of the experiment. (auth)

4118 CHARACTERIZATION OF A NEUTRON BEAM FOR RADIOBIOLOGICAL STUDIES. Parmentier, N. (CEN, Fontenay-aux-Roses, France); Bridier, A.; Chemtob, M. pp 59-81 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974). (In French).

From effects of neutron irradiation upon cell function; Nuremberg, F.R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Various measurement methods were employed in studying the relative biological effectiveness of a neutron beam emitted by a cyclotron: spectrometry; ionometry; measurement of the dose distribution as a function of linear energy transfer. Three neutron spectra, resulting from the impact of 16, 33 and 50-MeV deuterons on beryllium, were studied. The spectrometric method involved time-of-flight measurements, recoil proton counter measurements and the use of various activators. The ionometric measurements were made in tissue-equivalent and aluminium ionization chambers. In addition to measuring the dose due to incident gamma rays, the authors used thermoluminescent dosimeters. The dose distribution as a function of linear energy transfer was studied with a tissue-equivalent spherical proportional counter. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

4119 FEW NUCLEON SYSTEMS: APPLICATIONS. Brueckner, K. A.; Buchler, R. pp 913-927 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A brief review is given of the Thomas–Fermi model and some of its applications of astrophysical interest. It is shown that the Thomas–Fermi model is capable of reproducing the bulk properties of a wide range of nuclei. It is felt that the reliability of its predictions in r-process calculations and in the properties of neutron star matter by far exceeds that of conventional semi-phenomenological liquid-drop formulas. (auth)

Cosmic Radiation

Refer also to abstracts 3223, 3225, 3226, 3253, 3255, 4205, 4334, and 4918.

4120 (CONF-720724-P1, pp 448-457) ISOTOPE MEASUREMENTS OF LIGHT AND MEDIUM COSMIC RAY PARTICLES IN CELLULOSE NITRATE PLASTIC DETECTORS. Beaujean, R.; Enge, W. (Univ., Kiel). 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In cellulose nitrate sheets of a stack flown from Ft. Churchill in 1968 under 1.8 g/cm^2 altitude, stopping light and medium cosmic ray particles of about 100 MeV/nuc were measured. In 0.2 m^2 of the 1.6-m^2 stack 30 boron, 190 carbon, 83 nitrogen, and 263 oxygen particles were analyzed. A resolution of $\Delta M = \pm 0.7$ mass units and $\Delta Z = \pm 0.1$ charge units was obtained. With oxygen particles for a calibration at ^{16}O, the mean values of the mass distributions of the other elements are as follows: for boron, 10.79 ± 0.17; for carbon, 12.22 ± 0.08; and for nitrogen, 14.61 ± 0.12. (5 figures) (auth)

4121 (CONF-720724-P1, pp 458-464) LOW ENERGY IRON GROUP NUCLEI OBSERVED IN 1968 WITH NUCLEAR EMULSION. Fukui, K. (Air Force Cambridge Research Labs., Bedford, MA); Young, P. S. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A stack of nuclear emulsions, consisting of 168 sheets of G-5 Ilford emulsion, was flown from Fort Churchill, Canada in 1968. The flight lasted 10 hours at the atmospheric depth of 1.8 g/cm^2. All emulsions of the stack underwent area-scanning, and heavy stopping tracks were selected for the study of iron-group nuclei. The charge identification was made by width measurements of the thin-down portion of the tracks. The charge spectrum and the density of the tracks are presented, and the result is compared with the observations made by other investigators. (5 figures) (auth)

4122 (CONF-720724-P1, pp 465-475) CHARGE SEPARATION AND FLUX MEASUREMENT IN THE REGION OF THE IRON PEAK. Bartholomae, K. P. (Univ., Kiel); Enge, W.; Fukui, K. 1972.

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A study was made using Lexan polycarbonate plastic sheets as a particle detector in a balloon flight experiment flown from Fort Churchill at 1.8 g/cm^2 for about 10 hours. The analysis of the chemical composition is based upon the measurement of 313 stopping particles with energies between 150 and 400 MeV/nuc. The identification of the tracks of the particles is achieved by using the restricted energy loss criterion. The measured abundance of tracks is corrected for scanning and detector efficiencies corresponding to their charges. From a detailed study of the cone length versus residual range an accuracy of the charge determination around iron of ±0.3 charge units was found. Applying the above corrections yielded an even-Z to odd-Z ratio of 3. The ratios of Mn/Fe = 0.3, Cr/Fe = 0.4 and Ca + Sc + Ti/Fe = 1.1 were obtained. The measured fluxes are shown and discussed. (5 figures, 2 tables) (auth)

4123 (CONF-720724-P1, pp 476-484) PRELIMINARY STUDY OF THE CHARGE SPECTRUM OF ULTRA HEAVY COSMIC RAY PRIMARIES. Fowler, P. H. (Univ. of Bristol, Eng.); Jurak, A.; Thorne, R. T.; Ceallaigh, C. O.; O'Sullivan, D.; Rao, Y. V.; Thompson, A. (1972).

From eighth international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Results of a study of the charge spectrum of ultraheavy cosmic ray primaries obtained by using plastic track detectors and nuclear emulsions are presented. In May 1971, a 15 cm^2 stack consisting of Lexan polycarbonate and emulsion sheets with brass degrader, assembled in sixty modules, was exposed in two balloon flights launched from Sioux Falls, S. D. The payload was divided between the flights. The average ceiling attained in the first flight was 4.4 g/cm^2 of residual atmosphere for 37 hours. The duration of the second flight was 50 hours at an average ceiling of 4.6 g/cm^2. On landing after cutdown both payloads were dragged several miles—this occurrence caused some damage to the layers of the stack. The Lexan was etched in NaOH, and the emulsions were scanned with a low-power microscope. The observed charge spectrum of ultraheavy nuclei is shown. The results support previous findings that there is a concentration of nuclei around the platinum group and some evidence for the existence of transbismuth nuclei. No transuranic nuclei were found. (5 figures) (RWR)

4124 (CONF-720724-P2, pp 247-273) DOSIMETRY AT SST ALTITUDE. Allkofer, O. C. (Univ., Kiel). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Supersonic transports will cruise at such altitudes that the radiation dose is about 500 times its value at sea level. The basic features of cosmic radiation are described, including galactic radiation, solar cosmic radiation, the interaction with the atmosphere, geomagnetic effects, and modulation by solar influence. The composition of the cosmic ray flux at SST levels is discussed. Finally, dose distributions of various flare events are shown, and dose rates and ender fluxes for different charges of nuclei are tabulated. (21 figures, 6 tables) (RWR)

4125 (CONF-720724-P2, pp 274-283) MEASUREMENTS OF HEAVY NUCLEI AT THE LEVEL OF SUPERSONIC TRANSPORT USING PLASTIC STACKS. Allkofer, O. C.; Dispert, H.; Heinrich, W. (Univ. Kiel). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Stacks of 1500 foils (cellulose nitrate, cellulose acetate, Makrofol) were flown at altitudes of about 40 g/cm^2 for 6 hours. The charges of the particles were determined with an accuracy of ±1. The omnidirectional charge spectrum of the measured stopping is shown; the influence of the fragmentation in the air above the stack can be seen. The measured flux of thin-down hits for several charge ranges are given. (6 figures, 2 tables) (RWR)

4126 (MATSCIENCE-76, pp 241-258) COSMIC X-RAY BACKGROUND, BIG-BANG COSMOLOGY AND NEUTRINO EMISSION. Raychaudhuri, P. (Indian Statistical Inst., Calcutta). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

It is shown that the universal steady x-ray background with the energy flux $\approx 10^{-7}$ erg/(cm^2 · Sec. Sr.) can arise as a superposition of radiation from pulsars (neutron stars) in various galaxies when it is taken into account that supernova occurs in a galaxy at the rate of 10^{-2}/year. It is also pointed out that if the background x-rays are explained as a super-position of radiation from discrete sources, then a similar explanation of the microwave background is also solicited, thus restoring the steady state cosmologies to a position of prominence. Again it is pointed out that the spectroscopic determination of the helium abundance in the oldest stars of the galaxy is supported by the theory of stellar evolution when neutrino emission is considered according to the photon-neutrino coupling theory, if it is assumed that the population II stars started their life with a low surface helium content. This is an evidence against the big-bang cosmology. (auth)

4127 (N-72-32776) MODULATION OF COSMIC RAY ELECTRONS. Earl, J. A. (Maryland Univ., College Park (USA)). Jul 1972. 15p. (NASA-CR-128282). NTIS $3.00.

The origin and variations of the steep spectrum of electrons observed below 20 MeV are explained by a simple model in which the spectrum of interplanetary cosmic rays is decomposed, at low energies, into two independently varying components. (auth)

4128 (N-73-19841) NEUTRON MEASUREMENTS OF THE OGO-VI SPACECRAFT. Final Scientific Report. Lockwood,

J. A. (New Hampshire Univ., Durham (USA)). Jan 1973. Contract NAS5-9313. 84p. (NASA-CR-130181). NTIS $6.25.

The neutron measurements with the OGO-6 spacecraft are reported. Topics discussed include: the design and calibration of a neutron monitor for measuring the cosmic-ray neutron leakages from the Earth's atmosphere, determination of latitude dependence of cosmic-ray leakage flux, determination of the angular distribution of neutron leakage flux as deduced by measurements of the altitude dependence, and verification of the solar modulation of the cosmic-ray source for the neutron leakage. (STAR)

4129 MUON CHARGE-RATIO MEASURMENT AND COMPARISON WITH PREDICTION FROM HADRONIC SCALING. Ashley, G.K. II; Elbert, J.W.; Keuffel, J.W.; Larson, M.O.; Morrison, J.L. (Physics Department, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. Lett. 31: No. 17, 1091-1094 (22 Oct 1973).

The cosmic-ray muon charge ratio has been measured for muon momenta 0.7–4.5 TeV/c. It has also been calculated for a constant primary composition by applying scaling to nuclear-target data. The measurements, together with those at lower energies, are in good agreement with our predictions for primary collision energies up to 40 TeV. (auth)

4130 OBSERVATION 38-334-keV INTERPLANETARY PROTONS DURING SOLAR QUIET TIMES. Lin, R.P.; McGuire, R.E.; Anderson, K.A. (Space Sciences Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 31: No. 20, 1268-1271 (12 Nov 1973).

We present the first observations of quiet-time interplanetary protons in the energy range 38 to 334 keV from the Apollo 16 subsatellite. These proton fluxes vary by a factor of ~5 over a six-month period. Their spectrum can be represented by a power law $dJ/dE = 5.6E^{-1.3}$ (cm² sec ster keV)⁻¹ from 38 to 334 keV during May 1972. (auth)

4131 DIRECT ACCRETION OF ^{3}He AND ^{3}H FROM COSMIC RAYS. Lupton, J.E. (Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92037). J. Geophys. Res. 78: No. 34, 8330-8337 (1 Dec 1973).

The importance of the direct accretion of cosmic ray ^{3}He and ^{3}H is investigated in light of recently reported spacecraft measurements of the cosmic ray fluxes of these isotopes. The relevant solar and galactic cosmic ray data for solar cycle 20 are briefly reviewed, and average accretion rates are calculated for ^{3}He, ^{4}He, and ^{3}H by using these data and including the shielding effects of the geomagnetic field. These calculations indicate that, for energy thresholds of ~1 Mev/nucleon, the average cosmic ray accretion of ^{3}He, ^{4}He, and ^{3}H is small compared to other sources of these isotopes. With the data presently available, it is not possible to ascertain whether accretion of these isotopes is significant at energies below 1 Mev/nucleon. However, extrapolations from the existing measurements suggest that direct accretion of solar cosmic rays should not be excluded as a possible source of terrestrial ^{3}He and ^{3}H. For instance, if the solar flare ^{3}He spectra reported at ~10 Mev/nucleon can be extrapolated to energies as low as 10 kev/nucleon, the average accretion of solar ^{3}He may be as great as ~1 atom cm^{-2} sec^{-1}, comparable to terrestrial ^{3}He production by cosmic ray interaction in the atmosphere, precipitation from the solar wind, or the degassing of the earth. Possible measurements of atmospheric ^{3}He fluctuations following intense solar events are briefly considered in the context of current mass spectrometer techniques. (auth)

4132 COSMIC RAY DIURNAL ANISOTROPY 1937–1972. Forbush, S.E. (Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D.C. 20015). J. Geophys. Res. 78: No. 34, 7933-7941 (1 Dec 1973).

A previous investigation by Forbush (1969) showed that annual means of the cosmic ray diurnal anisotropy from 1937 to 1967 resulted from the addition of two distinct diurnal components. One, w, has its maximum (or minimum) in the asymptotic direction 128° east of the sun and is well approximated by a wave W with a period of 2 solar cycles. Wave W passes through zero in 1958, when the sun's poloidal field reversed. The remaining component with W eliminated has its maximum in the asymptotic direction 90° east of the sun. Annual means of this component, with its maximum at 18.0 hours local asymptotic time, are well correlated ($r = +0.75$) with magnetic activity and determine a solar cycle variation, the minimum being near sunspot minimum and the amplitude about two-thirds that of W. During the interval 1937–1967 or so, the 'period' of W was 20 years (that of the sunspot cycle was 10 years). If W were strictly periodic, its next change of sign after 1958 would have occurred in 1968. The present analysis shows this reversal of sign was delayed until 1971, near the time found for the latest reversal of the sun's polar magnetic field by Dr. Robert Howard of the Hale Observatories. These results derive from a statistical investigation of the variability of annual means of the diurnal variation from ion chamber data at Cheltenham–Fredericksburg, Huancayo, and Christchurch. The absolute, or total, diurnal anisotropy and the atmospheric diurnal temperature effect obtained are in reasonable agreement with those derived independently through a comparison of the diurnal anisotropy from ion chamber data and that from Simpson's 1953–1966 IGY neutron monitor data at Huancayo. (auth)

4133 ENERGY SPECTRUM AND FLUX OF 3- TO 20-MEV NEUTRONS AND 1- TO 10-MEV GAMMA RAYS IN THE ATMOSPHERE. Klumpar, D.M.; Lockwood, J.A.; St. Onge, R.N.; Friling, L.A. (Physics Department, University of New Hampshire, Durham, New Hampshire 03824). J. Geophys. Res. 78: No. 34, 7959-7967 (1 Dec 1973).

The flux and energy spectrum of fast neutrons ($3 < E < 20$ Mev) and γ rays ($1 \leq E \leq 10$ Mev) near the top of the atmosphere have been measured with an organic liquid scintillator. For a power law description of the omnidirectional neutron energy spectrum $N(E) = AE^{-\beta(E)}$ from 3 to 20 Mev at 3.5 g/cm² over Palestine, Texas ($P_c = 4.4$ Gv), the spectral index β depends strongly upon E. It changes from 1.8 ± 0.2 in the range $3 \leq E \leq 10$ Mev to $0.3_{0.4}^{+0.1}$ for $15 \leq E \leq 20$ Mev. From 20 to 50 Mev the neutron energy spectrum must be at least as flat as from 15–20 Mev to yield the observed proton recoil spectrum from 10 to 18 Mev, assuming that the neutron spectrum above 50 Mev varies as E^{-2}. The neutron energy spectrum had essentially the same shape at Ft. Churchill, Canada ($P_c = 0.3$ Gv). The neutron leakage current at $P_c = 4.4$ Gv from 3 to 10 Mev at solar minimum was 0.089 neutron/cm² sec and from 3 to 20 Mev was 0.12 neutron/cm² sec. The measurements reported here agree with recent calculations by Armstrong and Chandler and by Merker but exceed Lingenfelter's predictions by factors ranging from 2 to ~10. Assuming a power law description of the 1- to 10-Mev atmospheric γ ray energy spectrum, we find $\beta = 2.2 \pm 0.3$ for $1 \leq E \leq 4$ Mev and $\beta = 1.6 \pm 0.3$ for $4 \leq E \leq 10$ Mev for a partially unfolded count rate spectrum with a total flux of 0.66 photon/cm² sec at 3.5 g/cm² at $\lambda = 42°$N. Essentially the same spectral shape was found at Ft. Churchill, Canada. (auth)

4134 SPECTRUM OF ATMOSPHERIC GAMMA RAYS TO 10 MEV AT $\lambda = 40°$. Peterson, L.E.; Schwartz, D.A.; Ling, J.C. (Department of Physics, University of California at San Diego, La Jolla, California 92037). J. Geophys. Res. 78: No. 34, 7942-7958 (1 Dec 1973).

We report measurements of the differential counting rate spectra due to atmospheric γ rays as a function of altitude to 3.6 g/cm² over Texas. Two gain settings and a 128-channel pulse height analyzer were used to cover the range 0.2–10 Mev. The detector was a 7.6 cm×7.6 cm NaI crystal, which was surrounded on five sides by a 2-cm-thick plastic anticoincidence shield for charged particle rejection. The system had a nearly isotropic response to photons above 0.2 Mev. The spectrum at ceiling appeared as a steep continuum with a power law index of about 1.4. The only obvious feature was the 0.51-Mev positron annihilation line. The spectral shape was independent for depths less than 20 g/cm², the absolute intensity varying in proportion to the intensity of the cosmic ray secondary charged particles. Also, at depths less than 30 g/cm² the observed flux variation with altitude can be described in terms of an empirical depth-dependent source function . At 3.6 g/cm² the continuum flux had a value of 0.4 count/cm² sec Mev near 1 Mev, and the deduced strength of the 0.51-Mev line was 0.10 ± 0.005 photon/cm² sec. (auth)

4135 THE PARALLEL DIFFUSION OF COSMIC RAYS IN A RANDOM MAGNETIC FIELD. Klimas, A.; Sandri, G. (Aeronautical Research Associates of Princeton, Inc., Princeton, New Jersey). Astrophys. J. 184: No. 3, 955-965 (15 Sept 1973).

Within the quasi-linear approximation, we demonstrate the existence of the parallel diffusion coefficient for cosmic rays in a random magnetic field (homogeneous, isotropic) despite the slow decay of the interaction between particles and random field. As an example, we present the results of a numerical calculation of the parallel diffusion coefficient for a Gaussian random-field correlation function. The numerical results are corroborated by asymptotic analysis and are compared to those of other theories. (auth)

4136 THE ABUNDANCES OF GALACTIC COSMIC-RAY CARBON, NITROGEN, AND OXYGEN AND THEIR ASTROPHYSICAL IMPLICATIONS. Garcia-Munoz, M.; Mason, G.M.; Simpson, J.A. (Enrico Fermi Institute, University of Chicago). Astrophys. J. 184: No. 3, 967-994 (15 Sept 1973).

The differential energy spectra of galactic cosmic-ray C, N, and O nuclei have been measured from 20 to 1000 MeV per nucleon by University of Chicago instrumentation on board the IMP-4 and IMP-5 satellites, in 1967 and 1969, respectively. These results are compared with earlier University of Chicago measurements extending in time back to 1964 on the IMP and OGO satellite series. It is shown that the C/O and N/O ratios of abundances are not only independent of energy over the range 20 to greater than 1000 MeV per nucleon but are independent of solar-cycle modulation. Thus these ratios are also the ratios in the local interstellar space at higher energies. This

independence of the ratios on solar modulation makes it possible to compare directly these results with the measurements by other investigators using satellites and balloons. The measured C/O and N/O abundance ratios are 1.08 ± 0.08 and 0.28 ± 0.04, respectively. The relative abundances when the nuclei are ejected from galactic sources of C, N, and O have been calculated for different interstellar path-length distributions by assuming various equilibrium models of galactic propagation. It is concluded that even for different models of propagation, nitrogen must be present in the cosmic-ray source material with an abundance relative to oxygen similar to solar abundances and that the relative abundance of cosmic ray C:N:O leaving the sources is 0.92:0.11:1. The implications of these results are discussed with respect to identifying different candidates for the sources of cosmic-ray particles and the relationship of these sources to current theories of stellar evolution and nucleosynthesis. These results are compared with recent measurements by others of C, N, and O at very high energies. The paper contains a description of the instrumentation for carrying out these measurements on the IMP-4 and IMP-5 satellites, as well as details of the methods of calculations. (auth)

4137 ON KRAICHNAN'S DIRECT INTERACTION APPROXIMATION APPLIED TO CHARGED-PARTICLE TRANSPORT IN TURBULENT MAGNETIC FIELDS. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois). Astrophys. J. 184: No. 3, 995-1005 (15 Sept 1973).

We use Kraichnan's direct interaction approximation to set up equations describing charged-particle transport in turbulent magnetic fields. The equations are exact descriptions of possible dynamical systems, and, as such, are physically realizable. For two simple forms of the turbulent magnetic-field fluctuations we obtain the normal modes of propagation of the ensemble average distribution function. We also demonstrate how the conventional quasi-Fokker-Planck transport equations obtain as a simple approximation of the Kraichnan equations. Under the same type of turbulent field we also obtain the normal modes of propagation predicted by the quasi-Fokker-Planck equations. The only difference between the two approaches is a numerical factor $2^{1/2}$. If this holds true for more general classes of turbulent magnetic fields it will enable qualitatively correct physical answers to be found to cosmic-ray transport problems using the linear quasi-Fokker-Planck equations rather than the more correct, but more difficult, nonlinear Kraichnan equations. (auth)

4138 PRIMARY COSMIC RAY ELECTRONS ABOVE 10 GEV: MEASUREMENTS USING A THICK DETECTOR. Silverberg, R.F.; Ormes, J.F.; Balasubrahmanyan, V.K. (NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 78: No. 31, 7165-7173 (1 Nov 1973).

A balloon-borne measurement of the cosmic ray electron spectrum from 10 to 200 Gev is reported in which two new techniques have been used to remove proton background contamination. First, the depth of the spectrometer was more than 40 radiation lengths, the equivalent of more than 3 mean free paths of material, enabling hadronically and electromagnetically induced cascades to be differentiated for a subset of the data. Second, electromagnetic cascade starting points were determined to within ±0.1 radiation lengths on the basis of a calibration with electrons from 5.4 to 18 Gev at the Stanford Linear Accelerator, greatly reducing the chances for a proton to simulate an electron. The resulting spectrum, when fitted with a power law, is quite steep, -3.2 ± 0.1, but the fit to a power law is marginal. (auth)

4139 DIURNAL ANISOTROPIES OF THE COSMIC RAY INTENSITY UNDERGROUND DURING MAXIMUM SOLAR ACTIVITY. Antonucci, E.; Castagnoli, G.C.; Dodero, M.A.; Giraud, C. (Laboratoria di Cosmo-Geofisica del C.N.R., Istituto di Fisica Generale dell'Università, Torino, Italy). J. Geophys. Res. 78: No. 31, 7174-7183 (1 Nov 1973).

The diurnal variations of underground cosmic ray intensitites are analyzed on a day-to-day basis. At the depths of the London and Torino stations an anisotropy in the direction of the interplanetary magnetic field is observed in addition to the corotation effect, which varies in relation to the perturbations produced by the sun. This effect is not recorded in the Hobart data during the same period of observation. (auth)

4140 COSMIC-RAY ENERGY SPECTRUM FROM 10^{15} TO 10^{18} eV. Gaisser, T. K. (Bartol Research Foundation, Swarthmore, PA). Nature (London); 248: No. 5444, 122-124(8 Mar 1974).

It is stated that the problem of establishing the primary cosmic-ray energy spectrum at energies $\gtrsim10^{15}$ eV, a region of considerable astrophysical interest, depends for its solution on the relation between the size and total primary energy of extensive air showers, since the experimental data are directly related to EAS size spectra, which must be converted to a primary energy spectrum. The conversion depends, among other matters, on the hadronic past of the cascade and on the primary composition in an energy region in which such information is only available from EAS themselves. In the absence of independent knowledge of primary composition and the properties of high-energy interactions above $\sim10^{12}$ eV, a demonstration that the relation of shower size to primary energy is, to some extent, independent of these features would be valuable. Such an independence is suggested by comparison of the calculations here presented, which assume heavy primaries and Feynman scaling to relate shower size to primary energy, with calculations based on more conventional assumptions. Results give confidence that the energy spectrum is not subject to appreciable uncertainties arising from ignorance of primary composition or hadronic production mechanisms in the energy range considered. It is assumed that the primaries consist predominantly of heavy nuclei, such as Fe. (UK)

4141 MASS DEPENDENCE OF THE ENERGY SPECTRUM OF PRIMARY COSMIC RAYS. Daniel, B. J.; Hume, C. J.; Ng, L. K.; Thompson, M. G.; Whalley, M. R.; Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 1, L20-L24(1 Jan 1974).

There is experimental evidence favoring a flatter energy spectrum for primary iron nuclei than for the other charged components of the primary cosmic-ray beam, at least up to the highest energies at which measurements have been made ($\sim10^{12}$ eV/nucleon). In the present work the consequences of extrapolating this flatter spectrum to much higher energies are examined. (auth)

4142 ABSOLUTE DIFFERENTIAL SEA LEVEL MUON SPECTRA AT ZENITH ANGLES 45 AND 60°W NEAR THE GEOMAGNETIC EQUATOR. Bhattacharyya, D. P. (Presidency Coll., Calcutta). J. Phys., A (London); 7: No. 1, 158-166(1 Jan 1974).

The absolute sea level differential cosmic muon spectra at zenith angles 45 and 60° in the western azimuth have been determined near the geomagnetic equator (at 12°N) by using the range spectrograph in the momentum interval 0.5 to 3 GeV/c. The experimental muon spectra after corrections agree well with the spectra, calculated after Jabs theory for the same location, above muon momentum 1.8 GeV/c. The results have been compared with others obtained at higher latitudes. It is found that the variation of differential muon intensity with lg sec θ (θ is the zenith angle of the spectrograph axis) diminishes slowly with the increase of muon momentum from 1 to 3 GeV/c. The variation of the cosine exponent in the expression $I(\theta) = I(0)\cos^n\theta$ agrees with that calculated after Jabs. The present spectra after latitude corrections for 55°N agree well with that magnetic spectrograph result of Allkofer and Andresen for the same latitude at 45°W and with that of Judge and Nash for 60°W. (auth)

4143 LATITUDE EFFECT OF THE LOW MOMENTUM MUON SPECTRUM AT SEA LEVEL. De, A. K. (University Coll. of Science, Calcutta); Ghosh, P.; Das, A. K. J. Phys., A (London); 7: No. 1, 150-157(1 Jan 1974).

The sea-level absolute vertical cosmic-ray muon spectra at 12°N (Calcutta) have been measured in the range 0.35 to 2.2 GeV/c with a range spectrometer. These spectra are, on the average, 12% higher than those of Bhattacharyya at the same place of observation. The lower value of intensities of Bhattacharyya might be due to underestimation of scattering corrections and rejections of a few per cent of "single muons". The measured differential spectrum may well be represented by a form-fit spectrum. The Durgapur spectrum of Nandi and Sinha at 12°N at sea level is in agreement with the form fit spectrum up to 20 GeV/c. A comparison of this spectrum with the high-latitude form-fit spectrum of De et al. gives 1.23, 1.25, 1.21, and 1.07 latitude effect at the momentum ranges 0.3 to 0.5, 0.5 to 1.0, 1.0 to 2.0, and 2.0 to 5.0 GeV/c respectively. These values are more or less in agreement with those predicted from Olbert. Above 5 GeV/c the latitude effect is observed to vanish. (auth)

4144 HIGH ENERGY HADRONS IN AIR SHOWER CORES AT MOUNTAIN ALTITUDE. van Staa, R.; Aschenbach, B.; Boehm, E. (Univ., Kiel). J. Phys., A (London); 7: No. 1, 135-149(1 Jan 1974).

At the Pic du Midi (730 g cm^{-2}) in France an air shower array has been operated to study high-energy hadrons in air shower cores. The array consists of 13 scintillation counters of 0.25 m^2 each and a 14 m^2 high-energy hadron detector. 2050 showers with a total of 1600 hadrons of energy E > 100 GeV have been analyzed. The energy spectrum of hadrons (E > 300 GeV) is $H(>E) \sim E^{-\gamma}$ with $\gamma = 1.7 \pm 0.2$ independent of shower size in the size range $10^5 < N < 10^6$. It is compared with results of different air shower simulations. The lateral distribution can be expressed by $\rho(>E,r) \sim \exp(-r/r_0(>E))$ with $r_0 = 2.4(E/200\ \mathrm{GeV})^{-0.3\pm0.04}$ independent of shower size. It is not necessary to claim for large transverse momenta. (auth)

4145 IMPLICATIONS OF THE REPORTED LOW-ENERGY ELECTRON GRADIENTS. Lezniak, J. A.; Webber, W. R. (Univ. of New Hampshire, Durham). Solar Phys.; 34: No. 2, 477-489 (Feb 1974).

A recently reported measurement of a small electron gradient in the energy range 1.9 to 8.4 MeV by Webber et al. (1973a) is interpreted in terms of a large local value of the scattering mean free path for these particles. The possibility that the scattering mean free path may be large throughout the modulation region is then investigated under the assumption of an azimuthally symmetric modulation region of 5 AU extent, the applicability of the diffusion-convection-adiabatic energy loss transport equation, and a galactic origin for the low energy electrons. The implications for the solar modulation of electrons and the interstellar electron spectrum are discussed. (auth)

4146 NEW TEST FOR SOLAR MODULATION THEORY: 1972 MAY-JULY LOW-ENERGY GALACTIC COSMIC-RAY PROTON AND HELIUM SPECTRA. Garcia-Munoz, M.; Mason, G. M.; Simpson, J. A. (Univ. of Chicago). Astrophys. J.; 182: No. 2, L81-L84(1 Jun 1973).

For a three-month period in 1972 the low-energy galactic cosmic-ray proton and helium spectra were measured using the University of Chicago IMP-5 satellite experiment. Although the proton spectrum had a characteristic rising slope in the interval 30 to 100 MeV, the helium spectrum showed a previously unobserved feature: an intensity essentially independent of kinetic energy below 80 MeV per nucleon. Indeed, below ~35 MeV per nucleon, the helium flux exceeded the proton flux. It is pointed out that current models of solar modulation can account for the satellite observations 1965-1969, and the 1969-1971 period which included phase-lag effects during the recovery phase of current solar-cycle modulation. However, one cannot extend these techniques with previously successful boundary conditions and diffusion coefficient changes to fit all the features of the 1972 May-July observations below 100 MeV per nucleon. (auth)

4147 OBSERVATION OF GAMMA-RAY BURSTS OF COSMIC ORIGIN. Klebesadel, R. W.; Strong, I. B.; Olson, R. A. (Los Alamos Scientific Lab., NM). Astrophys. J.; 182: No. 2, L85-L88(1 Jun 1973).

Sixteen short bursts of photons in the energy range 0.2 to 1.5 MeV have been observed between 1969 July and 1972 July using widely separated spacecraft. Burst durations ranged from less than 0.1 s to ~ 30 s, and time-integrated flux densities from $\sim 10^{-6}$ ergs cm^{-2} to $\sim 2 \times 10^{-4}$ ergs cm^{-2} in the energy range given. Significant time structure within bursts was observed. Directional information eliminates the Earth and Sun as sources. (auth)

Stars

Refer also to abstracts 4216, 4291, 4309, 4318, 5117, 5135, and 5322.

4148 (MATSCIENCE-76, pp 78-82) PERIODS OF HIGHER MODES OF PULSATIONS. Singh, M. (Univ. of Roorkee, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The periods of different modes of the polytropic models with indices 1, 2, 3 and an early main sequence star of ten solar masses were studied. (auth)

4149 UBV PHOTOMETRY OF 4 MAGNETIC STARS. Winzer, J.E. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada). Astron. J. 79: No. 2, 124-127 (Feb 1974).

Differential UBV observations of four magnetic Ap stars are presented. No significant variations are detected for HD 2453 over a 14-month interval. A possible period of $10^d.61$ is suggested for 9 Tau=HD22374, although this period gives a poorly defined light curve. Well-defined light curves have been obtained for the other two stars, HD171586 and HD192913, which have periods of $2^d.1436$ and $15^d.478$, respectively. (auth)

4150 POLARIZATION OF SUPERNOVA REMNANTS KE 69, G 357.7-0.1, HC 26, AND γ CYGNI AT 6 AND 2.8 CM WAVELENGTHS. Kundu, M.R.; Velusamy, T.; Hardee, P.E. (Astronomy Program, University of Maryland, College Park, Maryland 20742). Astron. J. 79: No. 2, 132-138 (Feb 1974).

Distributions of brightness and linear polarization over the supernova remnants KE 69, G 357.7-0.1, HC 26, and γ Cygni were observed at 2.8 and 6 cm with beams of 3 and 6 arcmin, respectively. γ Cygni was observed only at 2.8 cm. Ke 69 shows an incomplete shell structure and a high degree of polarization (~ 20%). The rotation measures in these sources were computed from the position angles at 6 and 2.8 cm. The distributions of the projected magnetic fields were derived from the observed position angles at 2.8 cm. The field patterns in KE 69 and G 357.7-0.1 are roughly tangential and uniform, respectively. HC 26 and γ Cygni do not show any definite field pattern. (auth)

4151 COSMIC-RAY GENERATION BY PULSARS. Kennel, C.F.; Schmidt, G.; Wilcox, T. (University of California, Los Angeles, California 90024). Phys. Rev. Lett. 31: No. 22, 1364-1367 (26 Nov 1973).

Electromagnetic and particle energy fluxes are equipartitioned in a superrelativistic plasma wave. The consequences for cosmic-ray acceleration by pulsars are investigated. (auth)

4152 THE CLASSIFICATION OF INTRINSIC VARIABLES. IV. VERY-SMALL-AMPLITUDE, VERY-SHORT-PERIOD RED VARIABLES. Eggen, O.J. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. 184: No. 3, 793-799 (15 Sept 1973).

Photometry over extended intervals of eight red giants of the old disk population has (1) shown these objects to be very-small-amplitude (less than 0.2 mag visual) and very-short-period (20-40 days) variables and (2) indicated that the blue boundary of the red-variable instability region, previously found to be near R-I=+1.0 mag, is nearer 0.9 mag. A list of candidates for even shorter period, smaller amplitude, and hotter variables of this type, which might be called "σ Lib" variables, is included. (auth)

4153 STUDIES OF EVOLVED STARS. II. ON THE INTERPRETATION OF THE CN/C_2 AND CO/C_2 RATIOS IN COOL CARBON STARS. Scalo, J.M. (University of California, Los Angeles). Astrophys. J. 184: No. 3, 801-813 (15 Sept 1973).

The variation of the CN and C_2 abundances with temperature, pressure, and composition in the regions of line formation in cool carbon-star atmospheres is examined in detail for two possible mixing mechanisms: deep envelope mixing and plume mixing. The calculations differ from those of Tsuji and Morris and Wyller because of the inclusion of the CS molecule and the use of a different dissociation energy for CN. It is shown from elementary considerations that the N/C ratio in cool carbon stars cannot be unambiguously deduced from the CN/C_2 ratio unless O/H and C/O are specified simultaneously. A method for distinguishing between the two mixing mechanisms observationally on the basis of the CN/C_2 and CO/C_2 ratios is illustrated. (auth)

4154 METAL-POOR STARS. V. HORIZONTAL-BRANCH MORPHOLOGY. Rood, R.T. (California Institute of technology). Astrophys. J. 184: No. 3, 815-837 (15 Sept 1973).

Using theoretical models for horizontal-branch stars, various observational quantities such as color-magnitude (c-m) diagrams have been synthesized. The proposal that there is a dispersion in mass along the horizontal branch (HB) produces a good fit to observed c-m diagrams. In fact, it is so easy to achieve a fit in the c-m diagram that the parameters involved cannot be effectively limited, but still some important results emerge. It seems highly likely that some parameter other than age along a single evolutionary track must vary on the HB. The details of evolutionary tracks have only a minor effect on the appearance of the HB. As the heavy-element abundance Z varies from cluster to cluster, either the helium abundance must vary or the mean mass loss must vary. The "second parameter" affecting the HB is discussed in detail. Either helium variations of the order of 0.03 or age variations on the order of a billion years can account for the anomalous c-m diagrams. With certain assumptions the blueness of the HB is not a monotonic function of Z. Conclusive identification of the second parameter must await an adequate theory for mass loss along the red-giant branch and observations of the CNO abundances in the clusters. An effort to combine evolutionary theory with pulsation theory is largely unsuccessful. Quantities such as the fraction of RR Lyrae stars in the fundamental mode are extremely sensitive functions of the opacity used in the pulsation calculations. None of the presently proposed theoretical transition curves from fundamental to first harmonic variables is satisfactory. General trends such as a difference in mass and luminosity for the two Oosterhoff classes can be understood. The HB in the (surface gravity, effective temperature) -plane is briefly considered. (auth)

4155 THE NITROGEN ABUNDANCE OF THE VERY METAL-POOR STAR HD 122563. Sneden, C. (Department of Astronomy, University of Texas at Austin). Astrophys. J. 184: No. 3, 839-849 (15 Sept 1973).

The nitrogen abundance for the very metal-poor giant HD 122563 has been determined, using new spectroscopic plate data of the CH, NH, and CN molecular bands and a spectrum synthesis analysis. The

results indicate that nitrogen is overabundant by a factor of 15 relative to iron, while carbon is underabundant by a factor of 3. Account has been taken of the influence of the unknown oxygen abundance on the carbon equilibrium. (auth)

4156 ON THE HELIUM-SPECTRUM VARIATIONS OF 56 ARIETIS AND A CENTAURI. Mihalas, D. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 184: No. 3, 851-871 (15 Sept 1973).

It is shown that the observed helium-line variations in 56 Ari and a Cen can be explained by a surface distribution involving two symmetrically placed helium-rich caps at the poles of an axis inclined at a large angle to the axis of rotation. It is proposed that this axis be identified with the symmetry axis of a magnetic field with both toroidal and poloidal components, similar to that analyzed by Mestel and Takhar, and it is argued that the surface distribution may be a natural consequence of such a field. (auth)

4157 THE PERIOD AND SPECTRAL RANGE OF IK TAURI. Wing, R.F. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities); Lockwood, G.W. Astrophys. J. 184: No. 3, 873-880 (15 Sept 1973).

The mean period of IK Tauri, a very cool Mira variable, has been found to be 470 ± 5 days on the basis of 8 years of photometric observations in the 1-μ region. Its mean amplitude of 2.7 mag in I(104) is the largest known among Miras. The spectral type consistently reaches M10 at minimum light and has not been observed earlier than M8.1 at maximum. It is pointed out that, in the case of a Mira variable observed in only two consecutive cycles, a better estimate of the mean period can be obtained from the interval between successive maxima than from the interval between recurrences of the same magnitude. (auth)

4158 A COALSACK. I. A SEARCH FOR FLARE-STAR SPECTRA. Weaver, W.B. (Warner and Swasey Observatory, Case Western Reserve University). Astrophys. J. 184: No. 3, 881-885 (15 Sept 1973).

In 1320 square-degree-hours of objective-prism observations of the Coalsack, only one possible new flare star was discovered. This is contrary to expectations from preliminary work by other investigators, which suggested that many flare stars might be present and, as a corollary, that the Coalsack is a region of active star formation. (auth)

4159 THE LUMINOSITY EFFECT IN THE H- AND K-ABSORPTION FEATURES. Lutz, T.E. (Washington State University); Furenlid, I.; Lutz, J.H. Astrophys. J. 184: No. 3, 787-792 (15 Sept 1973).

The H- and K-absorption lines of Ca II are found to be good indicators of luminosity on classification dispersion spectrograms. The H- and K-absorption features broaden with increasing luminosity for stars in the range of spectral types from about F5 to K2. Computations of K-line profiles from LTE model atmospheres are in qualitative agreement with the observations. (auth)

4160 A NUMERICAL STUDY OF THE EXPLOSION OF A SUPERNOVA INTO THE INTERSTELLAR MAGNETIC FIELD. Rimer, N.; Jen, N.C. (The City College of the City University of New York). Astrophys. J. 184: No. 3, 887-895 (15 Sept 1973).

The earlier stages of the explosion of a supernova into the interstellar magnetic field are treated as the uniform expansion of a perfectly conducting spherical piston into an ideal magnetohydrodynamic (MHD) medium with a uniform magnetic field. A computer program is developed to solve the ideal MHD (Lundquist) equations in Lagrangian coordinates for two-dimensional unsteady flows. The von Neumann-Richtmyer method of artificial viscosity, developed for gas dynamics, is extended in order to permit the calculation of MHD flows involving shock waves. Rezoning is introduced to prevent large distortions of the Lagrangian mesh. Solutions are presented which indicate the effect of a magnetic field of arbitrary magnitude on the interstellar matter ahead of the expanding supernova shell. (auth)

4161 NEUTRON-STAR FORMATION IN THE CARBON-DETONATION SUPERNOVA. Wheeler, J.C. (Harvard College Observatory, Cambridge, Massachusetts); Buchler, J.; Barkat, Z.K. Astrophys. J. 184: No. 3, 897-906 (15 Sept 1973).

Neutrino losses, such as those driven by the convective Urca process, may affect the evolution of stars in the mass range 4-8 $M_\odot$ so as to lead to collapse of their degenerate carbon/oxygen cores. A corresponding hydrodynamic model is computed which leads to the formation of a 1.3 $M_\odot$-1.4 $M_\odot$ neutron star with the expulsion of a small fraction of the mass, $\sim 0.1\ M_\odot$, at $\sim 20{,}000$ km s^{-1} into the overlying hydrogen envelope. This sets the stage nicely for the Ostriker-Gunn mechanism in which Type II supernovae and pulsars are formed. (auth)

4162 NUCLEAR FUSION IN ACCRETING NEUTRON STARS. Rosenbluth, M.N.; Ruderman, M.; Dyson, F.; Bahcall, J.N. (Institute for Advanced Study, Princeton, New Jersey); Shaham, J.; Ostriker, J. Astrophys. J. 184: No. 3, 907-910 (15 Sept 1973).

We note that the total energy release from hydrogen accreting onto a neutron star consists of two entirely distinct contributions: (1) the gravitational potential energy loss by bringing additional mass down to the stellar surface; (2) the energy released in the fusion of the added hydrogen to form helium and heavier nuclei, about 7 MeV per nucleon. The fusion energy source is sufficiently far below the relatively opaque stellar surface that it heats the entire star and the whole surface becomes an X-ray source considerably cooler than the more localized source from contribution 1. These cooler X-rays may persist for many years after accretion is interrupted. We suggest that these notions could be relevant to some X-ray sources, perhaps even to the optical X-ray binary in Hercules. (auth)

4163 ON THE EVOLUTION OF MAGNETIC WHITE DWARFS. Fontaine, G.; Thomas, J.H.; Van Horn, H.M. (C. E. Kenneth Mees Observatory, University of Rochester, Rochester, New York). Astrophys. J. 184: No. 3, 911-915 (15 Sept 1973).

We show that the magnetic DC white dwarfs cannot have evolved from stars of spectral type DA. A separate origin is necessary, and a direct evolutionary connection between the magnetic DC stars and the nuclei of planetary nebulae seems plausible. Such a connection implies photospheric field strengths $\sim 10^6$-10^9 gauss in planetary nuclei, which may be large enough to be detectable. In addition, we find that magnetic white dwarfs must be hotter than some (weakly mass-dependent) limiting effective temperature. This prediction is potentially susceptible to observational verification. (auth)

4164 THEORY OF INTERSTELLAR ABUNDANCES OF THE ISOTOPES OF CARBON, NITROGEN AND OXYGEN. Wollman, E.R. (Department of Physics, University of California, Berkeley). Astrophys. J. 184: No. 3, 773-785 (15 Sept 1973).

It is shown that CNO hydrogen burning in stars of mass 3-8 $M_\odot$ can account for both the likely abundances of ^{13}C, ^{14}N, and ^{17}O in the interstellar medium and the observed ratios $^{12}C/^{13}C$ and $^{16}O/^{17}O$ in the atmospheres of evolved stars. A model which gives these abundances is shown to be consistent also with previously suggested mechanisms for the production of ^3He, ^{15}N, and ^{18}O. (auth)

4165 GRAVITATIONAL CONTRACTION OF PROTOSTARS. I. Bulk Losses of Energy. Kolesnik, I. G. (Astronomy Observatory, Odessa). Astrometriya Astrofiz.; No. 18, 45-58(1973). (In Russian).

Possible mechanisms which could lead to bulk losses of energy in protostars in the process of their gravitational contraction are analyzed. Particular attention is given to the effects of density and temperature on bulk energy losses, disregarding the internal pressure during the contraction of homogeneous isothermal protostars. Expressions are given to estimate the cooling effects of heavy elements, molecular hydrogen, and cosmic dust. Energy losses caused by dust are found to be the principal contributor to the cooling of contracting protostars. (IAA)

4166 INVESTIGATION OF PULSATING VARIABLE STARS. II. Radial Pulsations of RZ Lyrae. Kolesnik, I. G. (Astronomy Observatory, Odessa). Astrometriya Astrofiz.; No. 18, 59-64 (1973). (In Russian).

4167 VARIATIONS IN RZ LYRA PHOTOMETRIC CHARACTERISTICS WITH THE PERIOD OF THE BLAZHKO EFFECT. Romanov, S. (Astronomy Observatory, Odessa). Astrometriya Astrofiz.; No. 18, 65-78(1973). (In Russian).

Observations were made of the variable star RZ Lyra in 1968 through 1970, in a system close to the UBV system, on an electrophotometer mounted on a 64-cm meniscus telescope. The presence of a well-pronounced Blazhko effect is established. Brightness curves and color indexes of the star are included. (IAA)

4168 METAL ABUNDANCE AND THE LUMINOSITIES OF CEPHEIDS. Gascoigne, S. C. B. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 25P-27P(Feb 1974).

Semi-empirical arguments are advanced to show that, for a fixed color and period, a Cepheid with $Z = 0.005$ will be less luminous than one with $Z = 0.02$ by about 0.4 mag. Considered as distance indicators Cepheids are therefore rather sensitive to metal abundance. Some implications of this are discussed. (auth)

4169 MAGNETIC BRAKING BY A STELLAR WIND. IV. The Effect of Different Poloidal Field Structures. Okamoto, I. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 683-701(Mar 1974).

The theory of magnetic braking by a stellar wind is extended to cover a variety of assumed poloidal fields, all symmetric about the rotation axis, all dipolar angular structure, but with

radial structures varying from the curl-free at one extreme to the quasi-monopolar at the other. The rates of mass-loss $\dot{M}$ and angular momentum-loss $\dot{J}$ are computed as functions of four nondimensional parameters: l, the ratio of gravitational to thermal energy density, ζ, the ratio of magnetic to thermal density, κ, the ratio of the centrifugal force to gravity, all measured at the coronal base r_1; and a parameter λ that describes the structure of the poloidal field. Except for small values of ζ and large values of κ, an equatorial dead zone is formed, separated from the wind zone. It is confirmed that $\dot{J}/(\Omega_* r_1^2)$ is insensitive to changes in ζ for the dipolar field, where Ω_* is the star's angular velocity at the coronal base, but as the field structure changes from the dipolar to the radial, it becomes rather sensitive to ζ. For $\zeta \gg$ I, $\dot{J}/(\Omega_* r_1^2 \dot{M})$ increases very rapidly as κ decreases. Even in a hot corona, when κ is large the centrifugal force contributes as much to the braking effect of the wind as the thermal pressure. In reality, the field structure parameter λ is not independent of l, κ, and ζ but will be fixed by the trans-field component of the equation of motion. (auth)

4170 VARIABLE STARS IN THE LARGE MAGELLANIC CLOUD. Lindsay, E. M. Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 703-710(Mar 1974).

Data are given for nine new variables in the Large Magellanic Cloud and for some known Harvard variables. (auth)

4171 ULTRAVIOLET PHOTOMETRY OF EARLY TYPE STARS FROM TD1 SATELLITE OBSERVATIONS. Nandy, K.; Thompson, G. I.; Humphries, C. M. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 297-304 (Feb 1974).

Observations of over 200 stars brighter than V = 7.0m in the spectral type range from 0 to A5 have been used to verify an ultraviolet photometric system proposed in an earlier paper. This system consists of the ultraviolet color indices (U1-V) and (U3-U2) which yield a reddening free parameter ϕ, given by ϕ = (U1-V) - (U3-U2), for the determination of the spectral types of early type stars; the wavelengths of the magnitudes designated as U1, U2, and U3 are λ_1 = 2740 Å, λ_2 = 2500 Å, and λ_3 = 2190Å respectively, and V is the visual magnitude. The present observations contain a number of giants and supergiants and the effects of luminosity on the ultraviolet colors (U1-V), (U_2-U_1) and the parameter ϕ have been studied. The scatter in the relation between the classification parameter ϕ and quoted MK spectral types is also discussed. (auth)

4172 SPECTROSCOPIC SURVEY OF SOUTHERN HEMISPHERE WHITE DWARFS. IV. Radial Velocities and Space Motions. Wegner, G. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 271-280(Feb 1974).

New radial velocity measurements are reported for 31 southern white dwarfs. The K-term which is interpreted as the mean gravitational redshift, was estimated on the assumption of a mean solar motion for the white dwarfs. The K-term, space motions, and velocity ellipsoids were also derived for the white dwarfs from their radial velocities after combining the present data with Greenstein & Trimble's results for northern white dwarfs. With an assumed solar motion, the southern DA stars alone give a mean gravitational redshift of + 43 ± 14 km s^{-1} which is slightly lower than previous results. The possibility that the K-term could be enlarged by white dwarfs in moving groups is suggested. For the non-DA white dwarfs, the mean gravitational redshift was found to be lower, perhaps a result of pressure shifts. The velocity dispersions found for all the white dwarfs are comparable to the dM stars and suggests the white dwarfs are formed from old stars. The velocity dispersions for the non-DA (hydrogen-poor) stars may be slightly lower than for the DA (hydrogen-rich) white dwarfs. Some of the stellar evolutionary interpretations of these observations are briefly discussed. (auth)

4173 NEW HELIUM VARIABLE. Balona, I. (Royal Observatory, Cape Town); Martin, W. L. Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 35P-38P(Feb 1974).

The B-type star HD 175362 has been found to be a spectrum variable with a period of 3.7 days. The strongest variation occurs for the helium lines, but silicon and other lines are also suspected to vary, both in strength and width. (auth)

4174 LUMINOSITIES OF THE β CANIS MAJORIS VARIABLES. Jones, D. H. P.; Shobbrook, R. R. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 649-661(Mar 1974).

The luminosities of six β CMa variables are deduced from their membership of Scorpio-Centaurus; moreover the distance of α Vir has been measured interferometrically. The luminosities of the remaining variables are estimated from Hβ and Hγ after careful elimination of the effects of duplicity and systematic error. Intrinsic luminosity and color are closely correlated. The decreased distance to Sco-Cen proposed by Jones is supported by the interferometric distance of α Vir and by the gravities measured spectrophotometrically by Watson. If the pulsation hypothesis is to be retained then two different modes must occur, probably the fundamental and first overtone. The present discussion confirms the identification of the β CMa instability strip with the "S bend" phase of stellar evolution but Jones' distance scale requires that a normal Population I heavy element abundance be used, not the double value required by Lesh & Aizenman. (auth)

4175 STRENGTH OF Hα IN THE O-STARS. Osborn, W. (Instituto Venezolano de Astronomie, Merida, Venezuela). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 463-468(Feb 1974).

Observations of the strength of the Hα line in O-stars have been compared with the predictions of both LTE and non-LTE model atmospheres computed by Auer & Mihalas (Astrophys. J. Suppl.; 24:193(1972)). The use of Hα to test if non-LTE effects are important in the hydrogen spectra is shown to have several advantages over other commonly observed features, the principal one being that this test does not depend on an adopted spectral type-temperature relation. It is found that non-LTE effects are definitely important for O-stars. For main sequence stars the equivalent widths predicted by the non-LTE models are in excellent agreement with the observations, but for high luminosity stars the predicted widths appear to be too large. (auth)

4176 OBSERVATIONS OF RAPID BLUE VARIABLES. XIII. Rapid Pulsations in VW Hyi During Outburst. Warner, B.; Brickhill, A. J. (Univ. of Cape Town). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 673-681(Mar 1974).

Photometric observations on 1972 December 25—following an outburst of dwarf nova VW Hyi—show the presence of sinusoidal oscillations. These increased in period from 28 to 34 s within 4 hr. Good agreement is found from a comparison of these pulsations (and ones observed in other dwarf novae) with recent computations of nonradial quadrupole oscillations of white dwarf stars. (auth)

4177 COOLEST WOLF-RAYET STARS. Webster B. L.: Glass, I. S. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 491-497(Feb 1974).

Four emission-line stars, M4-18, He 2-113, CPD - 56°8032, and V348 Sgr, can be considered as a class, with low excitation surrounding nebulae, infrared radiation from dust grains and characteristic spectra dominated by CII emission lines. They appear to form a cool extension to the carbon sequence of the Population II Wolf-Rayet stars. V348 Sgr is of particular interest as it has features in common with both the R Coronae Borealis stars and the planetary nebulae. (auth)

4178 EFFECT OF INTERACTION ON THE STABILITY AND PULSATION OF ROTATING NEUTRON STARS. Ovsepyan, A. V. (Erevan State Univ.). Dokl. Akad. Nauk Arm. SSR; 55: No. 1, 36-41(1972). (In Russian).

The effect of interactions between neutrons on the stability and pulsation of rotating neutron stars is studied. The basic parameters of cold neutron stars are calculated and tabulated. The dependence of the mass of the equilibrium configuration on the central density is shown. The dependence of the rotation period and the radius of the equilibrium configuration on the mass is also shown. (JSR)

4179 STRONG VARIATION IN THE SPECTRUM OF RW Aur. Salmanov, I. R. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 3-5 (Jan 1972). (In Russian).

4180 STAR MASSES AND DISTANCES IN THE SPECTRAL BINARIES. Guseinov, O. Kh.; Novruzova, Kh. I. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 6-9(Jan 1972). (In Russian).

4181 LIFE DURATION AND AGE OF STAR CLUSTERS. Bouvier, P. (Sauverny Observatory, Geneva, Switzerland). Orion; 31: 171-175(Dec 1973). (In French).

The life duration of a stellar system in general is to be considered as the time that this system will take to disintegrate completely following its dynamic evolution. The age of the system in consequence is a fraction of its life duration, and it is evaluated most often with the help of astrophysical properties of stars which are members of the system. Also the life duration T and the age A imply that the system has been formed at a well defined epoch and, as far as T is concerned, that the final state of the system can be defined. The loss of mass by internal stellar

evolution, the effect of the galactic field tide, the passage of interstellar clouds and the internal dynamic evaluation of the clusters are discussed as causes of disintegration of star clusters. (IAA)

4182 SOLID STARS. Andrillat, H. (Saint-Michel-l'Observatoire, Alpes-de-Haute-Provence, France). Orion; 31: 175-180(Dec 1973). (In French).

The term "solid star" is somewhat surprising, when there is possible confusion with a planet, which certainly merits the name of "celestial body" but never that of "star." Here attention is given to stars which are so particular and consequently so few that it was necessary to await the latest technical developments of observation to prove their existence. The mass and equilibrium of a star is considered. A star is formed starting from great clouds of interstellar matter, such as the nebula of Orion. The end of stellar evolution and gravitational collapse are discussed. The stages of gravitational collapse, antagonistic pressures, and the densities of solid stars are treated, and comment is made on black holes. (IAA)

4183 EFFECT OF OBLATENESS ON THE STABILITY AND PULSATION OF ROTATING NEUTRON STARS. Vartanyan, Yu. L.; Kechiyants, A. M.; Ovsepyan, A. V. (Erevan State Univ.). Dokl. Akad. Nauk Arm. SSR; 56: No. 5, 290-294(1973). (In Russian).

Oblateness and its effect on the equilibrium parameters and the frequency of radial pulsations are studied for rotating neutron stars. The rest mass, pulsation period, gravitational energy, and rotational energy are calculated for oblate and spherical configuration as a function of the central density. (JSR)

4184 STRUCTURE OF FOUR 1612 MHz OH EMISSION SOURCES. Masheder, M. R. W.; Booth, R. S.; Davies, R. D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 561-583(Mar 1974).

Three M-type supergiant infrared/OH objects, NML Cyg, VY CMa, and VX Sag, and the W43A source have been studied with the Mark II-Mark III interferometer in the 1612 MHz OH satellite line. Detailed structure has been determined for the NML Cyg and VY CMa sources. The blue-shifted emission was found at the centre of the objects while the zero velocity emission (relative to the star) was found at the periphery. Both objects were elongated in a direction perpendicular to their apparent rotation axis. A model of these objects has been constructed from the observations which indicates an efflux of 5×10^{-3} solar masses per year from the vicinity of the central star. The implications of the results for theories of circumstellar clouds are discussed. (auth)

4185 RADIO EMISSION FROM R AQUARII. Gregory, P. C.; Seaquist, E. R. (Toronto Univ.). Nature (London); 247: No. 5442, 532-534(22 Feb 1974).

The detection of variable radio emission from this star is reported. The initial detection was made in April 1973 at 10.5 GHz using the 46m. telescope at the Algonquin Radio Observatory. The measured flux density was 95 ± 10 mfu, but further observations in May showed a flux density of 22 ± 10 mfu. Further observations were also made in June and August 1973 using the Greenbank three-element interferometer at 2695 and 8085 MHz; no significant short term variability was detected, and flux density measurements were consistent with a slow decay. A possible explanation of the radio emission is that it is optically thin thermal bremsstrahlung radiation from a denser central cloud of ejected matter surrounding the binary system. Variable radio emission could then be explained by a sudden ejection of matter by the star's blue component. A number of other features relating to R Aquarii are also discussed. (UK)

4186 THERMONUCLEAR ASTROPHYSICS. Clayton, D. D.; Woosley, S. E. (Rice Univ., Houston, TX). pp 717-771 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The types of thermonuclear reactions that are of importance to stellar evolution and nucleosynthesis are discussed, with particular attention to the explosive ejection of shells of He, C, O, and Si. Tables of the reactions important in the various burning phases are presented, including the reason for their importance and an estimate of the value of a carefully measured rate. This format is chosen for a dual purpose: (1) to clarify the astrophysics by showing which reactions play important roles and why they are important; (2) to clarify the nuclear needs by evaluating the importance of specific reactions within the astronomical settings and by assigning a value scale for cross-section measurements. (auth)

4187 POSSIBLE FREQUENCY OF PULSAR'S BIRTH. Guseinov, O. Kh.; Kasumov, F. K. Tsirk. Shemakh. Astrofiz. Observ.; No. 2, 8-11(Feb 1973). (In Russian).

4188 ABSOLUTE ENERGY DISTRIBUTION IN THE CONTINUUM OF 16 STARS. Aliev, G. I.; Gadzhiev, M. S.; Omarov, S. Z.; Shustarev, P. N. Tsirk. Shemakh. Astrofiz. Observ.; No. 3, 3-11(Mar 1973). (In Russian).

4189 IS IT POSSIBLE TO OBSERVE RELATIVISTIC STARS DURING ACCRETION. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 3, 12-14(Mar 1973). (In Russian).

4190 RADIUS OF HOT WHITE DWARF. Seidova, P. I.; Seidov, Z. F. Tsirk. Shemakh. Astrofiz. Observ.; No. 4, 3-5 (Apr 1973). (In Russian).

4191 ANALYTICAL APPROACH TO THE MASS: CENTRAL DENSITY RELATION OF COLD WHITE DWARFS. Seidov, Z. F. Tsirk. Shemakh. Astrofiz. Observ.; No. 4, 6-10(Apr 1973). (In Russian).

4192 ORBITAL MOMENTUM OF BINARY SYSTEMS CONTAINING WHITE DWARFS. Seidov, Z. F. Tsirk. Shemakh. Astrofiz. Observ.; No. 12, 3-5(Dec 1971). (In Russian).

4193 MASS DISTRIBUTION OF THE SINGLE STARS AND PRIMARY COMPONENTS OF DOUBLE SYSTEMS. Guseinov, O. Kh.; Novruzova, Kh. I. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 10-13(Jan 1972). (In Russian).

4194 BLACK HOLES, POSSIBILITY OF THEIR FORMATION AND THE FINAL STAGES OF STELLAR EVOLUTION. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 4, 3-10(Apr 1972). (In Russian).

4195 POSSIBLE SPECTRAL CHARACTERISTICS OF INVISIBLE COMPONENTS IN BS 1394, BS 1560, BS 1937, BS 2777, BS 4589, and BS 8264. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 5, 3-6(Mar 1972). (In Russian)

4196 DETERMINATION OF THE ELEMENTS FOR AR LAC. Babaev, M. B. Tsirk. Shemakh. Astrofiz. Observ.; No. 5, 7-11 (Mar 1972). (In Russian).

4197 INSTABILITY SEQUENCE OF STARS OF THE WOLF-RAYET TYPE. Gusein-Zade, A. A. Tsirk. Shemakh. Astrofiz. Observ.; No. 5, 12-13(Mar 1972). (In Russian).

4198 THICKNESS AND MASS OF RADIATIVE NONDEGENERATE ENVELOPE OF WHITE DWARFS. Seidova, P. I.; Eminzade, T. A. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 3-6(Jan 1973). (In Russian).

4199 ORIGIN OF WHITE DWARFS. Seidov, Z. F.; Eminzade, T. A. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 7-9 (Jan 1973). (In Russian).

4200 STUDY OF HYDROGEN LINES OF Ξ PER. Zeynalov, S. K. Tsirk. Shemakh. Astrofiz. Observ.; No. 10-11, 3-6(1971). (In Russian).

4201 ROTATION AND PULSATIONS OF PSEUDOPOLYTROPES. Seidova, P. I.; Seidov, Z. F. Tsirk. Shemakh. Astrofiz. Observ.; No. 10-11, 10-13(1971). (In Russian).

4202 DELTA GEM: A POSSIBLE COMPONENT OF A COLLAPSAR. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 10-11, 14-16(1971). (In Russian).

4203 2-MICRON MAP OF THE OPHIUCHUS DARK-CLOUD REGION. Grasdalen, G. L.; Strom, K. M.; Strom, S. E. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. J.; 184: No. 2, L53-L57(1 Sep 1973).

A 2-micron map of the Ophiuchus dark-cloud region has resulted in the discovery of a large number of infrared sources. These sources are interpreted as the brightest members of a cluster embedded within the dark-cloud region. The consequences of this conclusion are discussed briefly. (auth)

4204 HELIUM-3 IN IOTA ORIONIS B. Dworetsky, M. M. (California Inst. of Tech., Pasadena). Astrophys. J.; 184: No. 2, L75-L78(1 Sep 1973).

The wavelength of He I λ6678, as measured on coudé spectrograms of ι Ori B (B2p, He-weak), indicates that the helium con-

tent of the star's atmosphere is dominated by ^{3}He. The observed isotope shift of +0.42 ± 0.11 Å is similar to that found in 3 Cen A by Sargent and Jugaku. The two stars share several other spectroscopic anomalies; it is suggested that they constitute the first known members of a "new" class of peculiar early B stars. (auth)

4205 ORIGIN OF COSMIC RAYS, ATOMIC NUCLEI, AND PULSARS IN EXPLOSIONS OF MASSIVE STARS. Arnett, W. D.; Schramm, D. N. (Univ. of Texas, Austin). Astrophys. J.; 184: No. 2, L47-L51(1 Sep 1973).

Explosions of massive stars ($8 \lesssim M/M_\odot \lesssim 70$) are examined as the source of galactic cosmic rays. Detailed nucleosynthetic and evolutionary calculations suggest that these massive stars produce the heavy elements ($Z \geq 6$) in their proper relative abundances. This is particularly significant because lower-mass stars (in particular the 4 to 8 $M_\odot$ range) are unable to produce the observed abundances of C and O relative to the iron peak. A small (~1.4 $M_\odot$) dense remnant star left after the explosion may provide a location for an electromagnetic acceleration mechanism. Those abundance ratios which can now be predicted (He, C, O, Ne, Mg) for the material to be accelerated by the pulsar give a reasonable match to the observed cosmic-ray data. The conditions at the outer edge of the remnant and the inner edge of the ejected material may be appropriate for an r-process to occur; the high-Z cosmic rays seem to show an enrichment of r-process material. It appears that these stars may be the astrophysical source for the galactic cosmic rays. (auth)

4206 OBSERVATIONS OF SILICON MONOXIDE IN COOL STARS AT 4.05 MICRONS. Wollman, E. R. (Univ. of California, Berkeley); Geballe, T. R.; Greenberg, L. T.; Holtz, J. Z.; Rank, D. M. Astrophys. J.; 184: No. 2, L85-L88(1 Sep 1973).

Absorption due to the 3-1 vibration-rotation band head of $^{28}Si^{16}O$ at 2473 cm^{-1} has been detected in the atmospheres of a number of evolved giant and supergiant stars. The column density of $^{28}Si^{16}O$ in α Ori is determined to be $10^{21.1}$ cm^{-2}. None of the stars observed indicate measurable absorption due to the 2-0 band head of $^{30}Si^{16}O$ at 2467 cm^{-1}. A lower limit of 20 is established for the ratio $^{28}Si/^{30}Si$ in α Sco. (auth)

4207 NEW METHODS OF PROCESSING SPECKLE PATTERN STAR IMAGES. Knox, K. T.; Thompson, B. J. (Univ. of Rochester, NY). Astrophys. J.; 182: No. 3, L133-L136(15 Jun 1973).

A modification of Labeyrie's technique for processing star images degraded by atmospheric seeing is presented. The phase information is preserved in the deconvolution process by the addition of an off-axis coherent reference wave. As a result, the final image is the actual object intensity distribution rather than the autocorrelation of the object intensity. (auth)

4208 ACCRETION ONTO BLACK HOLES: THE EMERGENT RADIATION SPECTRUM. II. Magnetic Effects. Shapiro, S. L. (Princeton Univ., NJ). Astrophys. J.; 185: No. 1, 69-81(1 Oct 1973).

The influence of an interstellar magnetic field on the accretion of ionized gas onto a black hole is analyzed. The model is that of spherically symmetric, steady-state accretion of hydrogen gas onto a nonrotating black hole at rest in an H II region. The magnetic field lines are assumed to be finely tangled and randomly oriented in the interstellar medium. The dynamical flow of gas and the accretion rate onto the black hole are not substantially altered by the presence of the magnetic field for typical interstellar conditions. If the flow is turbulent and the magnetic energy density is comparable to the gravitational energy density throughout the infalling gas, as suggested by Shvartsman, Zel'dovich, and Novikov, then the computed luminosity due to synchrotron radiation is $L_s \simeq 5 \times 10^{25}\ (T_0/10{,}000°K)^{-3}\ (M/M_\odot)^3\ (n_0/1\ cm^{-3})^2$ ergs s^{-1}, provided $(T_0/10{,}000°K)^{-3}\ (M/M_\odot)(n_0/1\ cm^{-3}) \ll 10^3$. The observed radiation lies predominantly in the infrared part of the spectrum. The possibility of detecting this infrared flux and thereby identifying black holes in space is discussed briefly. (auth)

4209 SOME PHYSICAL PARAMETERS OF EARLY-TYPE STARS. Panagia, N. (Cornell Univ., Ithaca, NY). Astron. J.; 78: No. 9, 929-934(Nov 1973).

Using recent calibrations of the absolute magnitudes and temperatures and modern model atmospheres, six parameters of early-type stars were computed. These parameters are the absolute luminosity, the radius, the flux of Lyman continuum photons, the excitation parameter, the fraction of the total energy emitted in the Lyman continuum, and the ratio of the total luminosity of the stars to the expected Lyman-alpha luminosity. The calculations were performed for spectral types from B3 to O4 and for zero-age main sequence (ZAMS) stars, dwarfs (V), giants (III), and supergiants (I). Some of the above listed parameters were computed also for central stars of planetary nebulae. A critical comparison with previous calculations was made. A brief discussion about the interpretation of the radio and infrared observations of HII regions and planetary nebulae is also presented. (auth)

4210 ASTROMETRIC ANALYSIS OF THE TRIPLE STAR BD + 66°34. Hershey, J. L. (Swarthmore Coll., PA). Astron. J.; 78: No. 9, 935-938(Nov 1973).

Measurements of 575 plates taken over the interval 1938-1972 with the Sproul 24-in. refractor yield an average relative parallax of +0.100'' ± 0.002'' (p.e.) for the components A and B of the M-dwarf visual binary BD + 66°34. A provisional period of 320 yr has been determined for the pair. An analysis of the brighter component, which is an astrometric binary, yields a period of 15.95^y ± 0.22^y and photocentric semiaxis major a = +0.125'' ± 0.002'', from which a mass of 0.13 $M_\odot$ is derived for the invisible component. One of the two possible cases of orientation makes the orbits coplanar and corevolving. (auth)

4211 RADIO OBSERVATIONS OF PLANETARY NEBULAE AND A DISCUSSION OF THEIR EMISSION MEASURES. Terzian, Y.; Dickey, J. (Cornell Univ., Ithaca, NY). Astron. J.; 78: No. 9, 875-878(Nov 1973).

Radio observations of planetary nebulae at 430 MHz are presented. These observations were performed with the 1000-ft radio telescope at Arecibo. A detailed discussion of the emission measures of planetary nebulae is given. It is shown that these nebulae are composed of density clumps, which produce most of the radio radiation. (auth)

4212 GENERATION OF A STELLAR MAGNETIC FIELD BY CONVECTION IN THE OUTER REGION. Gurevish, L. E.; Eidel'man, E. D. Magn. Gidrodin.; No. 4, 3-11(1973). (In Russian).

The coefficient of generation of a poloidal magnetic field from a toroidal magnetic field under conditions of laminar convection caused by the super-adiabatic temperature gradient in the outer region of the star is obtained. It is shown that the coefficient of generation is proportional to the angular velocity of rotation of the star and the relative gradient of its density. In rapidly rotating stars the coefficient of generation is inversely proportional to its angular velocity and does not depend on the toroidal magnetic field available in the star. In slowly rotating stars the coefficient of generation is proportional to the angular velocity and with strong toroidal fields is inversely proportional to its square. (tr-auth)

4213 EXPLANATION OF THE INTRINSIC POLARIZATION OF THE LIGHT OF SOME RED LONG PERIOD VARIABLES. Friedemann, C. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1-2, 17-23(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The time-dependent polarization of the light of some red long-period variables can be explained on the basis of the model of the oblique rotator. Near the magnetic poles the dust particles in the outer layers of the stellar atmosphere can be aligned in the magnetic field by the Davis-Greenstein mechanism. The spatial orientation of the rotational axis is derived for four stars together with the angle between the magnetic poles and the rotational axis, and the period of revolution of the magnetic poles around the rotational axis. The proposed hypothesis gives an explanation of the essential observational facts concerning the intrinsic polarization of some of the red variables. (IAA)

4214 POLARIZATION IN Be-TYPE STARS. Martel, M. T. (Observatoire, Lyon). Astron. Nachr.; 293: No. 1-2, 9-10(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The influence of intrinsic polarization is demonstrated in a comparison of measured polarization values for two neighboring equally reddened stars, one of which is a normal B-type star and the other is a Be-type star. The values of measured polarization are very nearly the same for the two stars in the blue and visible, but the polarization of the Be star is always less than that of the normal B star in the ultraviolet. For three observed pairs of stars, the ratio of the uv interstellar and intrinsic polarization for the Be star to the uv interstellar polarization of the normal B star is approximately 0.7. (IAA)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 3413, 4184, 4187, 4211, 4314, 4324, and 4327.

4215 (MATSCIENCE-76, pp 31-47) MASSIVE SPHERES IN GENERAL RELATIVITY AND LARGE GRAVITATIONAL RED SHIFTS OF QUASARS. Durgapal, M. C.; Gehlot, G. L. (Jodhpur Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The effect of a layer of high density matter surrounding a spherical configuration was studied. It was shown that the maximum surface red shift z_s can be as large as 4,828. A model of quasars was proposed in which the large red shift of emission and absorption lines has been explained as being gravitational in nature. It is also shown that z_s and mass/radius ratio increases when a sphere is surrounded by a layer of high density matter. (auth)

4216 POSSIBILITY OF NEUTRINO EMISSION FROM MATTER ACCRETING INTO A NEUTRON STAR. Ruffini, R. (Physics Department, Stanford University, Stanford, California 94305); Wilson, J. Phys. Rev. Lett. 31: No. 22, 1362-1364 (26 Nov 1973).

We analyze the possibility of neutrino emission from matter accreting into a neutron-star member of a binary x-ray source. Estimates of the expected fluxes and neutrino energy are given for selected values of the accretion rate under the assumption that the neutrino production is mainly due to the reaction $\gamma + e^- \rightarrow \nu_e + \bar{\nu}_e$. (auth)

4217 INTERFEROMETRIC SURVEY OF PLANETARY NEBULAE. Cahn, J.H.; Rubin, R.H. (University of Illinois Observatory, Urbana, Illinois 61801). Astron. J. 79: No. 2, 128-131 (Feb 1974).

A survey of radio fluxes and positions of planetary nebulae is reported using the NRAO three-element interferometer. [The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under contract with the National Science Foundation.] The survey represents an attempt to quickly obtain fluxes and positions of weak sources in the range 0.010-0.100 f. u. Sucessful observations are reported on 69 planetary nebulae. (auth)

4218 EFFECT OF COMPTON SCATTERING ON X-RAY SPECTRA. Chapline, G. Jr.; Stevens, J. (Lawrence Livermore Laboratory, University of California). Astrophys. J. 184: No. 3, 1041-1050 (15 Sept 1973).

By studying the asymptotic forms of the solutions to the nonrelativistic Compton Fokker-Planck equation we are able to derive approximate analytic formulae for the changes in a bremsstrahlung spectrum due to Compton scattering in the emitting gas. Our formulae cover the entire range of electron scattering optical depths $0 < \tau_s < \infty$ and can be used up to electron temperatures of 20 keV. (auth)

4219 SUSPECTED PERIODICITY IN THE RADIO FREQUENCY SPECTRUM OF PSR 0329 + 54. Jones, D. A.; Lyne, A. G. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 39P-42P (Mar 1974).

A periodicity in the radio frequency spectrum of PSR 0329 + 54 has been reported by Sturrock et al. (Astrophys. J.; 171:L27 (1972)). Approximately 12 times the data available to them were analyzed, with no sign of any obvious, consistent periodicity. It is concluded that the apparent periodicity is due to random scintillation in the interstellar medium. (auth)

4220 STRUCTURE OF THE CRAB NEBULA. IV. The Variation of Polarization With Wavelength. Wilson, A. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 617-631 (Mar 1974).

This paper attempts to interpret recent data on the distribution of polarization in the Crab Nebula in terms of the internal structure of the nebula. If the depolarization by bright filaments which is observed at $\lambda = 6$ cm also occurs at $\lambda = 1.55$ cm, as low-resolution studies suggest, a magnetic field component along the line of sight of $\langle B_{\parallel} \rangle > 2 \times 10^{-4}$ Gauss exists in some of these filaments. The polarization behavior in the direction of the optical bays may be explained if they contain thermal gas. If the rotation measure of the pulsar NP 0532 is characteristic of the interstellar medium, as suggested by Manchester, it is likely that all the rotation of the plane of polarization intrinsic to the nebula occurs in condensations of gas with gaps of density $N_e < 10^{-2}$ cm^{-3} in between. The distribution of Faraday rotation intrinsic to the nebula does not show the pattern to be expected for a toroidal magnetic field "wound up" by the pulsar. (auth)

4221 ANALYSIS OF QUASAR SAMPLES. Jackson, J. C. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 281-295 (Feb 1974).

This paper is largely about technique; the method devised by Lynden-Bell (Mon. Not. R. Astr. Soc.; 155:95(1971)) to allow for observational selection effects in complete quasar samples is extended to deal simultaneously with several samples, each with its own selection criteria; expressions giving the uncertainty in the answers obtained are also derived. The method is illustrated using 3CR and 4C quasar samples, and resulting density evolution, color, and optical luminosity functions are presented and discussed. (auth)

4222 RADIO SOURCE STRUCTURE, CLUSTERS OF GALAXIES, AND THE COMPLEX SOURCES. Hooley, T. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 259-270 (Feb 1974).

Correlations between the properties of extragalactic radio sources and membership of clusters of galaxies are examined for a complete sample of radio galaxies. It is found that there is no difference in the overall sizes of double radio sources in clusters and those in the general field. There is no preference for complex radio sources to be associated with clusters of galaxies. Complex structure is observed only in low power sources, and such sources are larger on average than other types. No evidence is found for any difference in properties between radio sources in clusters and those in the general field. It is inferred that there is no evidence from the radio data for increased ambient gas density in clusters of galaxies. (auth)

4223 HOT PULSAR MAGNETOSPHERES. Henriksen, R. N.; Rayburn, D. R. (Queen's Univ., Kingston, Ont.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 409-424 (Feb 1974).

The equilibrium of the co-rotating zone of the pulsar magnetosphere is investigated. It is suggested that the particle density is much higher than the charge density and that the required heat input to maintain hydrostatic equilibrium is supplied by plasma turbulence in the ion-sound mode. The radiation properties of the resulting hot plasma are investigated. Finally a criterion is given for determining the extent of the co-rotating zone. (auth)

4224 NON-ALIGNED COMPONENTS IN EXTRAGALACTIC RADIO SOURCES. Harris, A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 449-461 (Feb 1974).

Recent high-resolution observations of "double" radio sources show significant nonalignment of the structure within the components of the double in relation to the axis of the source. There is no clear relationship between the nonalignment in the two components of each source, nor any dependence of the magnitude of the nonalignment on other physical properties of the sources. The parent galaxies of these double sources are sometimes displaced from the straight line joining the outer radio peaks of the source. The nonalignment of the component structure could result from turbulent motions in the medium surrounding the radio source if the components are confined by ram-pressure and their velocities are $\lesssim 0.02c$. In the "bubble" model of Gull & Northover (Nature; 244:80(1973)) the observed structures would arise from asymmetries or irregularities in the distribution of the intracluster gas; this model also imposes limits on any motions in the gas. (auth)

4225 5GHz OBSERVATIONS OF SIX OH OBJECTS. Harris, S. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 29P-34P (Feb 1974).

Six OH objects have been observed at 5 GHz with the Cambridge 5-km telescope. Those of Type I (W75N(OH), ON1, and ON2) were all detected, whereas those of Type IIb (NML Cyg, IRC + 50137, and ON4) were not, which is in general agreement with previous results. (auth)

4226 INITIAL RESULTS FROM A RADIO CONTINUUM SURVEY OF THE AREA AROUND NGC7331 AND STEPHAN'S QUINTET. Gillespie, A. R. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 11P-15P (Feb 1974).

Observations of a $2^\circ \times 2^\circ$ region centered on $\alpha = 22^h\ 34^m\ 40^s$, $\zeta = 36^\circ\ 10'$ at 1421 MHz have revealed an excess of radio sources in a small area north of Stephan's Quintet. It is shown that the density of sources observed is not likely to be due to chance, and some implications of this result are discussed. (auth)

4227 CONFUSING RADIO SOURCE NEAR THE PLANETARY NEBULA IC2149. Sistla, G.; Kaftan-Kassim, M. A. (State Univ. of New York, Albany). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 17P-19P (Feb 1974).

High-resolution dual-frequency observations of the planetary nebula IC 2149 show that the nebula is confused by a nearby source, thus accounting for the apparent nonthermalicity. The position and spectrum of the confusing source are given. (auth)

4228 OPTICAL IDENTIFICATIONS FOR 45 RADIO SOURCES BASED ON ACCURATE POSITIONS. Hoskins, D. G. (Univ. of Sydney); Murdoch, H. S.; Adgie, R. L.; Crowther, J. H.; Gent, H. Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 235-247 (Feb 1974).

Optical identifications are given for 32 of 45 sources based on accurate radio positions measured with the Royal Radar Establishment interferometer. Both the optical and the radio positions used are sufficiently accurate (~0.5 arcsec) that reliable identifications can be made on the basis of position alone. A high proportion of the sources have "abnormal" radio spectra. For these the identification content is high (80 per cent) including four identifications with stellar objects of neutral color. (auth)

4229 UPPER BOUND ON THE ELECTRIC CHARGE OF A BLACK HOLE. Zaumen, W. T. (Lockheed Missles and Space Co., Palo Alto, CA). Nature (London); 247: No. 5442, 530-531 (22 Feb 1974).

Expressions are given for the energy of a rotating charged black hole, and for the charge and angular momentum, also for an upper bound on the charge. With regard to the latter this can be derived by considering loss of charge by pair production. If the electric field of the black hole creates an electron–positron pair outside the event horizon one of the particles can enter the black hole and the other can travel to infinity. The process will occur only if the decrease in total energy of the black hole for a unit change in charge is sufficient to produce a free electron or positron. The discussion presented is limited to negatively charged black hole, so that the ingoing particles are positrons. (UK)

4230 RADIO STRUCTURE OF THE DOUBLE QUASAR 4C11.50. Stannard, D.; Wilkinson, P. N.; Warwick, R. S.; Davis, R. J. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 247: No. 5442, 527-528(22 Feb 1974).

Discovery of a close pair of optical quasars associated with the radio source 4C11.50 has recently been announced, and it has been suggested that the radio structure may be double, with one component coincident with the brighter quasar. The alignment of the radio structure was investigated further by the present authors, seeking in particular any evidence of a radio connection between the two optical quasars. Observations were made with radio link interferometers at Jodrell Bank during November–December 1973. Parameters describing the radio structure were assigned using a model fitting technique that assumes components with elliptical gaussian distributions of surface brightness. Simple double models failed to provide a satisfactory fit to the data, which did not justify any model more complicated than involving a single unresolved component. Results suggested that the stronger component may be variable at cm. wavelengths; there were also indications that extended structure of low surface brightness may be present, to which the high-resolution interferometers were insensitive—synthesis observations at lower spatial frequencies are needed to define such structure. It is concluded that the evidence on the radio structure of 4C11.50 presented suggests that there is no radio association between the two optical quasars. (UK)

4231 MODELS OF EXTRAGALACTIC RADIO SOURCES WITH A CONTINUOUS ENERGY SUPPLY FROM A CENTRAL OBJECT. Scheuer, P. A. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 513-528(Mar 1974).

This paper explores the dynamics of radio source models in which energy is carried from a nucleus to the radio components by a relativistic beam. Only a small fraction of the energy supply can be radiated away from the tip of the beam, and the rest lingers on in a cavity surrounding the beam. For the dynamical development of the source it is not of great importance whether the "beam" consists of strong electromagnetic waves or of fast particles with or without magnetic fields, or even if the energy is supplied from a moving massive object instead of the tip of a beam. If the energy in the cavity contains both fast electrons and magnetic fields, then the cavity rather than the tip of the beam is likely to be the site for the greater part of the radio emission. When the lateral expansion of the cavity becomes subsonic, the outer parts of the cavity swell at the expense of the parts nearest the massive nucleus, where the thermal gas pressure is higher. (auth)

4232 PULSE BROADENING DUE TO MULTIPLE SCATTERING IN THE INTERSTELLAR MEDIUM. III. Williamson, I. P. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 499-512(Mar 1974).

Several observers have shown that the pulses received from distant pulsars at low frequencies are broadened in time, presumably by interstellar scattering. Two previous papers have discussed the pulse shapes expected from various model configurations of the interstellar medium and these theoretical pulse shapes are here compared with the observations of broadened pulses from five pulsars. It is found that the pulse shape generated by a model in which scattering occurs uniformly throughout the medium does not fit the observations, nor is the initial rise of the pulse as sharp as would be expected if the scattering were confined to a thin screen. Various interpretations of these results are discussed. (auth)

4233 LUMINOSITY OF PULSARS. Guseinov, O. Kh.; Kasumov, F. K. Tsirk. Shemakh. Astrofiz. Observ.; No. 4, 11-14 (Apr 1973). (In Russian).

4234 HD 77581 AS THE OPTICAL COUNTERPART OF 2U 0900-40. Vidal, N. V.; Wickramasinghe, I. T.; Peterson, B. A. (Australian National Univ., Canberra). Astrophys. J.; 182: No. 2, L77-L79(1 Jun 1973).

Photoelectric observations of the light curve of HD 77581 made in 1973 between January 22 and March 6 are found to be consistent with the 8.95-day x-ray period of 2U 0900–40. (auth)

4235 VARIATIONS IN THE RADIO STRUCTURE OF BL LACERTAEE. Clark, B. G. (Cornell Univ., Ithaca, NY); Kellermann, K. I.; Cohen, M. H.; Shaffer, D. B.; Broderick, J. J.; Jauncey, D. L.; Matveyenko, L. I. Astrophys. J.; 182: No. 2, L57-L60(1 Jun 1973).

The structure of the rapid variable radio source BL Lac (VRO 42.22.01) was observed, using long baseline interferometer systems with baselines up to 266 million wavelengths. Despite large variations in the total flux and in the overall size of this source, it has maintained an elongated brightness distribution, and the direction of elongation has not changed during the 1.3 years of observation. No simple model of stationary variable components or of separating, evolving components appears to fit all the data for this source. In particular, it apparently cannot be explained in terms of a stationary brightness distribution with a single variable component of very small angular size. The peak brightness temperature of VRO 42.22.01 is in excess of 5×10^{12}°K at 11 cm wavelength, a value close to the limit set by inverse Compton scattering. (auth)

4236 CHARACTER OF OPTICAL VARIABILITY OF THE QUASAR 3C 273. Chertoprud, V. E. (Astronomical Council, Moscow); Gudzenko, L. L; Ozernoy, L. M. Astrophys. J.; 182: No. 2, L53-L56(1 Jun 1973).

The results of recent works referring to "slow" (~10 years) brightness variations of the quasar 3C 273, as well as the pertinent observational data are discussed. The validity of an earlier conclusion that the light curve of 3C 273 is incompatible with the model of independent random pulses is confirmed in a new way. (auth)

4237 APPARENT ASSOCIATION OF QUASI-STELLAR OBJECTS WITH CLUSTERS OR GROUPS OF GALAXIES WITH ABOUT THE SAME REDSHIFT. Burbidge, G. R.; O'Dell, S. L. (Univ. of California, San Diego). Astrophys. J.; 182: No. 2, L47-L51(1 Jun 1973).

The statistical evidence for the association of QSOs with clusters or groups of galaxies of about the same redshift is examined. It is shown that, due to the uncertainty in the number density of cluster centers for all but moderately rich compact clusters, it is premature to conclude that the present evidence for the association of QSOs with such groups or clusters is statistically significant. (auth)

4238 MAGNETIC OBSERVATIONS OF THE X-RAY BINARIES HD 77581 AND HD 153919. Angel, J. R. P. (Univ. of Texas, Austin); McGraw, J. T.; Stockman, H. S. Jr. Astrophys. J.; 184: No. 2, L79-L83(1 Sep 1973).

Narrow-band circular polarization measurements made together with profile scans of Hα in HD 77581 and HD 153919 do not indicate significant Zeeman splitting. Individual measurements yield field values from 40 to 900 gauss, consistent with random errors expected from photon statistics assuming no magnetic field. Accurate measurements of the field in 53 Cam were obtained as a test of the measurement technique. (auth)

4239 EMISSION-LINE SPECTRUM OF THE VELA X SUPERNOVA REMNANT. Osterbrock, D. E.; Costero, R. (Univ. of Wisconsin, Madison). Astrophys. J.; 184: No. 2, L71-L73 (1 Sep 1973).

Photoelectric spectrophotometric measurements of the bright filament A in Vela X are presented. The previously reported unusually large Hα/Hβ ratio is not confirmed. The observed spectrum deviates significantly from the spectra of H II regions and planetary nebulae, but agrees qualitatively with the predicted spectra of shock-wave supernova models, in particular with the Cox model with $V = 141$ km s^{-1}. (auth)

4240 OBSERVATIONS OF THE HIGHLY VARIABLE X-RAY SOURCE GX 339-4. Markert, T. H.; Canizares, C. R.; Clark,

G. W.; Lewin, W. H. G.; Schnopper, H. W.; Sprott, G. F. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 184: No. 2, L67-L70(1 Sep 1973).

Observations with the MIT experiment on the OSO-7 have led to the discovery of an x-ray source, GX 339-4, which varies in intensity by at least a factor of 60 over hundreds of days but shows no evidence of periodic behavior or abrupt intensity changes on time scales from 3 minutes to 13 days. The observations show intense high states, low states with spectra consistent with increased absorption, and off states, when no statistically significant signal is observed. The behavior is unlike that of any previously reported x-ray source. (auth)

4241 OPTICAL STUDIES OF UHURU SOURCES. VI. Photoelectric Photometry of HD 153919 = 2U 1700-37. Jones, C.; Liller, W. (Harvard College Observatory, Cambridge, MA). Astrophys. J.; 184: No. 2, L65-L66(1 Sep 1973).

Photoelectric observations of HD 153919, the optical candidate for the x-ray source 2U 1700-37, have revealed regular intensity variations with a period consistent with the 3.412-day x-ray period. The optical light curve shows two maxima and two minima every 3.4 days with a total visual amplitude of 0.08 mag. No changes in color were observed. (auth)

4242 SECOND OF ARC POSITIONS AND FLUX DENSITIES OF 1583 RADIO SOURCES AT 365 MHz. Ghigo, F. D.; Owen, F. N. (Univ. of Texas, Austin). Astron. J.; 78: No. 9, 848-874 (Nov 1973).

The positions and flux densities are reported for 1583 sources at 365 MHz, obtained at the University of Texas Radio Astronomy Observatory with the broadband synthesis interferometer. Most of the sources have position errors in each coordinate of 1 to 2 arcsec. An analysis of the position differences and relative flux scale of these measurements with respect to those included in the Bologna B2 Survey is also presented. (auth)

4243 LINE AND CONTINUUM RADIO OBSERVATIONS OF SOURCES IN THE CYGNUS X REGION. Terzian, Y. (Cornell Univ., Ithaca, NY); Parrish, A. Astron. J.; 78: No. 9, 894-897 (Nov 1973).

Continuum millimeter radio observations, and hydrogen radio recombination line observations are reported for sources in the Cygnus X region. A discussion of the physical parameters for the observed sources is given. (auth)

4244 MEASUREMENTS OF THE FLUX DENSITY AND SPECTRA OF DISCRETE RADIO SOURCES AT CENTIMETER WAVELENGTHS. IV. The Observations at 10.7 GHz (2.8 cm). Kellermann, K. I. (National Radio Astronomy Observatory, Green Bank, WV); Pauliny-Toth, I.I.K. Astron. J.; 78: No. 9, 828-847 (Nov 1973).

The flux density of 500 discrete radio sources were measured at 10.7 GHz (2.8 cm) and are presented. The accuracy of the measurements was limited by receiver noise to about 0.015 f.u. and by uncertainties in the variation of the gain of the receiver and antenna, and in the atmospheric extinction to 3% or 4%. The absolute flux density scale was estimated to be correct to within 5%. (auth)

Solar Phenomena

Refer also to abstracts 3360, 3361, 4131, 4409, and 4891.

4245 (N-73-17828) MONITORING OF SOLAR FAR ULTRAVIOLET RADIATION FROM THE OSO-5 SATELLITE. Final Report, June 1964-September 1972. Rense, W. A.; Parker, R. (Colorado Univ., Boulder (USA). Lab. for Atmospheric and Space Physics). Sep 1972. Contract NAS5-3931. 32p. (NASA-CR-130159). NTIS $3.75.

A spectrophotometer for monitoring the solar euv in three broad wavelength bands is described. The kind of data obtained, along with sources of error, are presented. The content of the tape library which contains the data is outlined. The scientific results are discussed. These include the following: solar flares in the euv, solar eclipse observations in the euv, SFD's and relationship to solar flares, and the application of satellite sunrise and sunset data for the study of model upper atmospheres for the Earth (auth) (STAR)

4246 RESISTIVE DIFFUSION OF FORCE-FREE MAGNETIC FIELDS IN A PASSIVE MEDIUM. II. A NONLINEAR ANALYSIS OF THE ONE-DIMENSIONAL CASE. Low, B.C. (Enrico Fermi Institute, University of Chicago). Astrophys. J. 184: No. 3, 917-929 (15 Sept 1973).

We investigate the force-free magnetic field $B=[\cos\phi\ (z,t),\sin\phi\ (z,t),0]$ to ascertain when it may develop infinite field gradients while undergoing resistive diffusion in a passive medium (Low). A complete analysis of the nonlinear evolution of B is given, subject to the conditions (i) $\phi\ (z,0)$ is an odd and increasing function of the Cartesian coordinate z and (ii) $\phi\ (\pm\infty,t) = \pm\phi_0$ for all time, where ϕ_0 is finite and independent of time. If the total rotation of B along the z-axis exceeds half a revolution, i.e., $2\phi_0 > \pi$, we find that B always develops infinite field gradients after a finite period of time, irrespective of the initial distribution $\phi\ (z,0)$. The modest criterion $2\phi_0 > \pi$ supports our suggestion that this type of instability triggers the eruption of flares in the solar chromosphere. If $2\phi_0 < \pi$, we find that B always evolves toward a uniform field, irrespective of the initial distribution $\phi\ (z,0)$. The marginal case $2\phi_0 = \pi$ admits an unstable steady state. We use the properties of this steady state to show how a quantitative theory of homologous flares might be constructed. (auth)

4247 THE TRAPPED MAGNETOATMOSPHERE WAVES. Nakagawa, Y.; Priest, E.R. (High Altitude Observatory); Wellck, R.E. Astrophys. J. 184: No. 3, 931-953 (15 Sept 1973).

The trapped (vertically nonpropagating) magnetoatmospheric waves are examined on the basis of local dispersion relations governing the propagation of magnetoacoustic and magnetogravitational waves in an inviscid atmosphere of infinite electrical conductivity permeated by a uniform magnetic field. It is shown from the necessary condition that trapped waves are possible, (1) when the magnetic field is purely horizontal, (2) when the magnetic field is purely vertical, and (3) when the magnetic field has both vertical and horizontal components for waves propagating perpendicular to the magnetic field. Through examinations of the sufficient conditions for each of these three specific circumstances, the domain of trapped waves is determined in the (angular frequency, horizontal wavenumber) -plane. It is shown that for a horizontal magnetic field, most of the magnetoatmospheric waves become trapped, except for the magnetoacoustic waves. It is shown also that for a vertical or a general magnetic field, most of the magnetoatmospheric waves with the frequency below the local Brunt-Väisälä frequency could become trapped. The physical significance and possible practical application of the results to solar observations are discussed. (auth)

4248 SOLAR WIND DISTURBANCES DETECTED BY THE INTERPLANETARY SCINTILLATION OF RADIO SOURCES IN EARLY AUGUST 1972. Watanabe, T.; Kakinuma, T.; Kojima, M.; Shibasaki, K. (Research Institute of Atmospherics, Nagoya University, Toyokawa, Aichi, Japan). J. Geophys. Res. 78: No. 34, 8364-8366 (1 Dec 1973).

This letter reports the spatial structure of disturbances as deduced from the interplanetary scintillation (IPS) of several radio sources. The radio observations (69 MHz) were carried out at three separate locations in central Japan at the meridian passages of radio sources 3C48, 3C144, 3C147, 3C161, and 3C273. (AIP)

4249 COMMENTS ON PAPER BY K. ROGER PYLE, 'PROPAGATION ANISOTROPIES OF SOLAR FLARE PROTONS AND ELECTRONS AT LOW ENERGIES IN INTERPLANETARY SPACE'. Rao, U.R.; Allum, F.R.; McCracken, K.G. (The University of Texas at Dallas, Dallas, Texas 75230). J. Geophys. Res. 78: No. 34, 8409-8411 (1 Dec 1973).

Pyle has recently extended the investigation of anisotropies present in solar particle radiation to energies as low as 0.66 Mev and has concluded that at these low energies the particle flow even in the early part of the flare event is directed from approximately 30° east of the magnetic field direction for almost every case that he has studied. (AIP)

4250 SOLAR FLARE COSMIC RAY INCREASE OF AUGUST 7, 1972. Mathews, T. (Department of Physics, University of Calgary, Calgary, Alberta, Canada). J. Geophys. Res. 78: No. 31, 7537-7538 (1 Nov 1973).

Observations of the August 1972 cosmic ray storm at high rigidities using underground muon telescopes at Mount Chacaltaya (Bolivia) and Embudo Cave and Socorro (New Mexico), has set an upper-limit rigidity of 20-25 Gv to the solar protons contributing to the ground level event (GLE) on August 7, which resulted from the importance 3B solar flare. (AIP)

4251 RISE TIME TO MAXIMUM FLUX OF RELATIVISTIC SOLAR ELECTRON EVENTS AND ITS RELATION TO THE HIGH-FREQUENCY COMPONENT OF THE INTERPLANETARY FIELD POWER SPECTRUM. Lanzerotti, L.J.; Venkatesan, D.; Wibberenz, G. (Department of Physics, University of Calgary, Calgary, Alberta, Canada). J. Geophys. Res. 78: No. 34, 7986-7995 (1 Dec 1973).

The time to maximum flux of 13 relativistic ($\beta \gtrsim 0.8$) solar electron events from western hemisphere flares is used to estimate the local

scattering mean free path based on a propagation model with a radially constant diffusion coefficient. These electrons undergo resonance scattering by interplanetary magnetic field fluctuations corresponding to frequencies of $\gtrsim 10^{-1}$ Hz at the orbit of the earth. It is found that the estimates of the electron mean free paths are quite consistent with the mean free paths calculated for rigidities P~310–369 Mv by Sari (1972) from interplanetary field power spectra when Sari's values are extrapolated to the electron rigidities ($P \lesssim 1$ Mv). It is concluded that the variability from event to event in the time to maximum electron flux from western hemisphere flares is to be expected from the variability observed by Sari in the interplanetary field power spectra at the lower frequencies ($\lesssim 10^{-3}$ Hz). (auth)

4252 EFFECTS OF SOLAR WIND COMPOSITION, ANISOTROPY, AND STREAMING ON ORDINARY MODE ELECTROMAGNETIC INSTABILITY. Buti, B. (Space Science Division, Ames Research Center, Moffett Field, California 94035). J. Geophys. Res. 78: No. 34, 8023-8031 (1 Dec 1973).

The stability of the low-frequency waves ($\omega < \Omega_i$) propagating transverse to the magnetic field of the plasma, which is composed of electrons, protons, and α particles with anisotropic electron and ion temperatures, is explored. The threshold for the ordinary mode instability and the growth rates have a very strong dependence on the electron temperature anisotropy but have a comparatively weaker dependence on the ion temperature anisotropy, on the relative abundance of helium to hydrogen, and on the relative streaming of two ion species. The threshold for the instability of these low-frequency waves is $(m_e/m_p)^{1/2}$ times smaller than the one corresponding to high-frequency waves; however, for the relative abundance of helium to hydrogen up to 20% for the relevant known magnetic fields, particle densities, temperatures, and drifts, the solar wind remains below the threshold for this instability. (auth)

4253 SOLAR WIND STREAM INTERACTIONS AND INTERPLANETARY HEAT CONDUCTION. Hundhausen, A.J. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado 80302). J. Geophys. Res. 78: No. 34, 7996-8010 (1 Dec 1973).

The compression of plasma in solar wind stream interaction regions (where a fast-moving stream overtakes slower-moving material) implies the existence of a heat source for solar wind electrons. The resulting electron thermal structure is largely determined by a balance between the rate of compressive heating in this 'interaction region' source and the rate of thermal conduction away from the region. Two different quantitative models of the thermal structure are derived under the common simplifying assumptions of a steady state, a negligible spatial extent for the heat source, and a radial magnetic field line geometry. The models employ contrasting assumptions about the heat conduction process; one is based upon a 'classical' thermal conductivity, and the other uses a 'saturated' heat conduction flux density. The predicted dependence of electron temperature increase on the characteristics of the stream interaction region is significantly different for the two cases. It is thus suggested that observations of electron temperatures in such regions could be used to examine the nature of the interplanetary heat conduction process. (auth)

4254 AZIMUTHAL PROPAGATION OF LOW-ENERGY SOLAR FLARE PROTONS: INTERPRETATION OF OBSERVATIONS. McKibben, R.B. (Laboratory for Astrophysics and Space Research, Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). J. Geophys. Res. 78: No. 31, 7184-7204 (1 Nov 1973).

In an earlier paper (McKibben, 1972) observations were presented of solar proton fluxes at an energy of ~17 Mev, which showed that after some large solar flares the proton flux at the orbit of the earth became approximately independent of solar longitude within about 4 days. Flux differences at these late times were typically less than a factor of ~2 at spacecraft separated by as much as 180° in solar longitude. These observations were found to be consistent with an effective $k_\perp \cong 7 \times 10^{20}$ cm²/sec at the orbit of the earth. In this paper this conclusion is examined more closely, and the possible interpretations of the results presented earlier are discussed. An attempt is made by using simple physical arguments to derive an estimate of the effective $k_\perp$ in the interplanetary field from known properties of the field, including the effects of the random walk of field lines as proposed by Jokipii and Parker (1969), the result being that for the cases considered the effective $k_\perp$ is found to be much smaller than the $k_\perp$ required by the solar flare observations. Observations of 17-Mev protons in corotating regions are presented, and they also are found to lead to upper limits on the effective $k_\perp$ that are significantly less than the $k_\perp$ required by the solar flare results. Alternative models of azimuthal propagation are discussed that do not require a large $k_\perp$ in near-earth interplanetary space. Models are considered in which azimuthal propagation takes place primarily in a spherical shell far outside the orbit of the earth, in a region above and below the ecliptic plane, and in the upper solar corona. Some experimental evidence is found in support of the hypothesis that azimuthal propagation takes place primarily inside the orbit of the earth. (auth)

4255 ANISOTROPIES IN RELATIVISTIC COSMIC RAYS FROM THE INVISIBLE DISK OF THE SUN. Duggal, S.P.; Pomerantz, M.A. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081). J. Geophys. Res. 78: No. 31, 7205-7220 (1 Nov 1973).

The most recent (September 1–2, 1971) of the rare ground level events signaling the arrival at the earth of relativistic solar cosmic rays arising from a flare on the sun's invisible hemisphere displayed marked anisotropy for several hours. Application of newly developed analytical procedures has made it possible to study in detail the evolution of the anisotropic pitch angle distribution. Throughout the anisotropic phase the solar particle flux is proportional to the cosine of the angle between the weighted mean asymptotic direction of viewing and an axis of symmetry corresponding to the spiral interplanetary magnetic field line that connects the sun to the earth. Furthermore, the degree of anisotropy deduced from the ratio of the fluxes in the garden hose direction toward and away from the sun decays exponentially. The results of this analysis and the reexamination of the three previously observed invisible hemisphere ground level events have demonstrated that propagation along the spiral interplanetary field line connecting the sun to the earth occurs even when the source lies far beyond the limb of the sun. In one case (January 28, 1967) the anisotropy near onset was 100% (i.e., no particles traveling toward the sun), a situation that had only been reported twice previously and then in association with visible flares that occurred within 10° of the foot of the nominal garden hose field line. These results bespeak the operation of an efficient transport mechanism in the solar corona that enables relativistic protons to travel over distances at least as great as 70° in heliolongitude in about 15 min. (auth)

4256 ALFVÉN WAVES IN SPIRAL INTERPLANETARY FIELD. Whang, Y.C. (Department of Plasma Physics, Royal Institute of Technology, Stockholm, Sweden). J. Geophys. Res. 78: No. 31, 7221-7228 (1 Nov 1973).

This paper presents a theoretical study of the Alfvén waves in the spiral interplanetary magnetic field. The Alfvén waves under consideration are arbitrary large-amplitude non-monochromatic microscale waves of any polarization. They superpose on a mesoscale background flow of thermally anisotropic plasma. When the WKB approximation is used, an analytical solution for the amplitude vectors is obtained as a function of the background flow properties: density, velocity, Alfvén speed, thermal anisotropy, and the spiral angle. The necessary condition for the validity of the WKB approximation is discussed. The intensity of fluctuations is calculated as a function of heliocentric distance. The relative intensity of fluctuations compared with the magnitude of the background field has its maximum in the region near 1 AU. Thus outside of this region the solar wind is less turbulent. Owing to attenuation of microscale Alfvén waves, fluctuation energy is converted into the kinetic energy of the solar wind. Its contribution amounts to about 20% of the kinetic energy at 1 AU. (auth)

4257 SOLAR WIND PROPERTIES AT THE EARTH AS PREDICTED BY THE ONE-FLUID MODEL WITH HELIOCLASSICAL THERMAL ELECTRON CONDUCTIVITY. Durney, B.R. (Advanced Study Program National Center for Atmospheric Research, Boulder, Colorado 80302). J. Geophys. Res. 78: No. 31, 7229-7236 (1 Nov 1973).

The solar wind properties at the earth are computed for a variety of values of the density and temperature at the base of the corona. For the electron thermal conductivity the expression derived by Perkins is adopted. Good agreement with observations is obtained for values of the density and temperature at the base of the corona equal to $\sim 9 \times 10^7$ cm^{-3} and $\sim 1.7 \times 10^6$°K, respectively. (auth)

4258 SHOCK SYSTEM OF FEBRUARY 2, 1969. Unti, T.; Neugebauer, M. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103); Wu, C. J. Geophys. Res. 78: No. 31, 7237-7256 (1 Nov 1973).

The shock system observed in the solar wind by Pioneer 9 and Ogo 5 on February 2, 1969, consisted of the following major discontinuities: a forward slow shock, a forward fast shock, a tangential discontinuity at which the density dropped sharply and the flow direction changed, a tangential discontinuity at which the magnetic field strength jumped to an unusually high value, two closely spaced tangential discontinuities that bracketed a region of even greater field strength and that fronted a region of very cool, very dense, helium-enriched plasma, a reverse fast shock of low Mach number, and a second reverse fast shock of very low Mach number. The event had aspects of both corotating and flare-induced shock systems; it is suggested that the source of the disturbances was a flare occurring at or near an M region. The Ogo 5 search coil magnetometer detected a high level of turbulence throughout the event; a local enhancement of this turbulence at the front of the helium enrichment is believed to have been caused by a magnetic drift wave instability. Data are also presented for two other shock pair systems, both of which had density and flow direction profiles similar to those observed on February 2, 1969. (auth)

4259 SEARCH FOR HIGH ENERGY GAMMA RAYS FROM THE SUN. Kim, C. Y. (Univ. of Calgary, Alberta). Can. J. Phys.; 52: No. 3, 197-201(1 Feb 1974).

An attempt to measure the flux of high energy solar gamma rays was made by comparing the angular distribution of the intensity from the direction of the Sun and that of the intensity from the symmetrical direction about the zenith using two stacks of oriented nuclear emulsions flown by balloon on May 16, 1970, from Sioux Falls, South Dakota. An upper limit to the flux of solar gamma rays was estimated to be 4.3×10^{-4} photons cm^{-2} s^{-1} in the energy region above 10 MeV. On the day of the flight the Sun was moderately active and the relative sunspot number was 161. Three importance-2 flares (2N, 2N, and 2B) and five importance-1 flares were reported during the period of the balloon flight. (auth)

4260 ORIGIN OF THE ASTEROIDS. Napier, W. M.; Dodd, R. J. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 469-489(Feb 1974).

Three hypotheses concerning the origin of asteroids were examined, viz. that the asteroids are collisional fragments deriving from a few primaeval planetoids; that they are the remnants of a planet which disrupted; and that they are in process of forming a single body by random aggregation. Monte Carlo simulations and theoretical arguments were used to predict mass distributions and rotation periods. It was found that the accretion hypothesis was not in good agreement with observations; but that both the collisional fragmentation and exploded planet theories were consistent with the observed asteroidal rotations and mass distribution. Physical arguments were used to show that accretion within the asteroid belt, through the intermediary of jet stream formation, is probably not taking place, and that the exploded planet hypothesis meets with severe difficulties. It was concluded that, most probably, the asteroids are debris arising from the collisional shattering of a few primal bodies, some of which may still survive intact. (auth)

4261 IRRADIATED HISTORY AND ORIGIN OF GAS-RICH METEORITES. Rajan, R. S. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 38: No. 5, 777-788(May 1974).

With the transmission electron microscope, detailed studies were made of the track density gradients and irradiation geometries of track-rich grains and chondrules in sections of Fayetteville and Kapoeta. The same type of studies have been made in sections of lunar breccias and grains from lunar soil for comparison. A substantial fraction (50 to 90 per cent) of the meteoritic track-rich grains and chondrules shows evidence of having been irradiated anisotropically in their different faces, as would be expected for irradiation on the surface of a parent body. The observations thus support the hypothesis that the irradiation of these grains and chondrules took place on the regoliths of asteroidal-sized bodies. Measurement of steepest track density gradients indicates that while there are finite differences between spectra exhibited by individual gas-rich meteorites, the average solar flare spectra shapes have been similar over the last ~4 b.y. or so. (auth)

4262 MOTION OF ZODIACAL DUST PARTICLES. I. Radial Velocity Measurements on Fraunhofer Line Profiles. Hicks, T. R.; May, B. H.; Reay, N. K. (Imperial Coll. of Science and Tech., London). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 439-448(Feb 1974).

An experiment to record the spectrum of the Zodiacal Light in the neighborhood of the Mg I absorption line (5183.6 Å) is described. Measurements were made of the Doppler shift imposed on the absorption line by the motion of the interplanetary dust particles. Observations were concentrated on the ecliptic plane, spectra being obtained at lower elongation angles from the Sun than previously achieved, and also over the entire range of high elongations including the Gegenschein. The reduction methods applied to the data are described and compared, and the new results are presented. (auth)

4263 INTERNAL ROTATION OF THE SUN AND THE SOLAR NEUTRINO FLUX. Roxburgh, I. W. (Queen Mary Coll., London). Nature (London); 248: No. 5445, 209-211(15 Mar 1974).

Arguments for a rapid central rotation of the Sun, causing a low neutrino flux, are discussed. (UK)

4264 DETECTION OF METHYL CYANIDE IN COMET KOHOUTEK. Ulich, B. L. (National Radio Astronomy Observatory, Tucson, AZ); Conklin, E. K. Nature (London); 248: No. 5444, 121-122(8 Mar 1974).

It is stated that most current models of comets assume that the nucleus is an icy solid body containing complex "parent" chemical compounds that sublimate and dissociate to provide the radicals and simple molecules observed in the spectra. The first direct detection of a "parent" molecule CH_3CN, at a wavelength of 2.7mm in the comet Kohoutek is here reported, using the NRAO 11m radio telescope at Kitt Peak, Arizona, with a beam-switching mode. The lines observed were identified with 6,3 to 5,3 and 6,0 to 5,0 vibrationally excited transitions of CH_3CN at 110,704.55 and 110,712.22 MHz. Calculations were made of the optical depth and column density of CH_3CN. The results provided the first direct confirmation of the "parent-daughter molecule" hypothesis. (UK)

4265 METEORITIC MAGNETITE AS A COSMOTHERMOMETER. Herndon, J. M.; Rowe, M. W. (Texas A and M Univ., College Station). Nature (London); 247: No. 5442, 531-532(22 Feb 1974).

Reference is made to Latimer (Science 112: 101(1950)) and Urey who discussed the oxidation states of Fe in the dust phase of the solar nebula. In this connection the presence of magnetite in carbonaceous chondrites has frequently been cited as a cosmothermometer to infer accretion temperatures of ≲400K. The validity of this approach is discussed and thought to be inappropriate. (UK)

4266 SOLAR FLARES AND THE LENGTH OF THE DAY ON THE EARTH. Elgaroey, O. Forskningsyntt; 19: No. 1, 24-28(1974). (In Norwegian).

Following a brief discussion of sunspots and solar flares the effects of the latter on the Earth's atmosphere are considered. X radiation causes radio noise and shock waves, and particles cause magnetic storms and aurorae. The advent of the cesium clock in 1955 has made it possible to study irregular variations in the Earth's rotation. In 1962 Danjou published data which he interpreted as showing a correlation between these irregular variations and solar cosmic radiation. Other observers, however, found this effect doubtful. An unexpected sunspot maximum in 1972 was accompanied by several flares. Corresponding irregular variations in the earth's rotation were observed. Comparisons between data from various observatories render this evidence doubtful, however. One possible mechanism is that solar protons captured in the magnetosphere can increase the Earth's inertia to such an extent that a measureable change in its angular velocity occurs. Satellite data indicate that this effect would be too small. A more probable cause would be that capture of solar protons in the magnetosphere leads to release of heat in the upper atmosphere. This leads in turn to changes in the circulation pattern in the winds, causing a temporary braking effect on the Earth. (NO)

4267 FROM PLASMA TO PLANET, NOBEL SYMPOSIUM 21, SEPTEMBER 6, 1971. Elvius, A. (ed.). Stockholm; Almqvist and Wiksell (1972). 389p.

This volume contains the proceedings of the Nobel Symposium 21 "From Plasma to Planet". The symposium was held at Saltsjoebaden, southeast of Stockholm, Sweden, September 6–10, 1971. During the five days nine sessions were held, viz. 1. Chemical state of plasma and gas in space. 2. Irradiation of grains in space. 3. Interaction of plasma and gas with solids. 4. Chemical studies of meteorites and Moon. 5. Small bodies in the Solar System. 6. Formation of comets. 7. Space research and the origin of the Solar System. 8. Plasma dynamics. 9. Future space exploration in relation to research on the origin of the Solar System-general discussion. (auth)

4268 SOLAR MICROWAVE BURSTS AND THEIR ASSOCIATION WITH SOLAR PROTON FLARES. Harris, L. D. J. J. Brit. Astron. Ass.; 84: 9-15(Dec 1973).

Solar radiation and its terrestrial effects are considered together with solar microwave radio telescopes, solar microwave bursts, methods available for forecasting proton streams, and factors affecting the successful forecasting of a proton stream. A single microwave radio telescope operating in the frequency region from 5 to 20 GHz can be used to monitor solar activity. An approach involving the simple measurement of the duration and intensity of a burst provides a rapid means of forecasting the probability of an associated proton stream. (IAA)

4269 CERTAIN PROPERTIES OF SOLAR CHROMOSPHERIC FLARES ASSOCIATED WITH DECIMETER WAVE RADIO BURSTS. Koeckelenbergh, A. (Observatoire Royal de Belgique, Brussels). Ciel Terre; 89: 453-461(1973). (In French).

4270 OBSERVATIONS OF THE SOLAR SPECTRUM IN THE REGION 150 A TO 870 A EMITTED FROM THE DISK AND ABOVE THE LIMB. Firth, J. G.; Freeman, F. F.; Gabriel, A. H.; Jones, B. B.; Jordan, C.; Negus, C. R.; Shenton, D. B.; Turner, R. F. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 543-560(Mar 1974).

Photographic spectra have been obtained in the grazing-incidence region from a position on the quiet solar disk and from a region just above the visible limb. The payload, which was launched on a Sun-stabilized Skylark rocket, contained three grazing-incidence spectrographs, each illuminated by a two-component grazing-incidence telescope mirror. One of these, which was viewing the limb spectrum, was fitted with a fine-alignment servo system to stabilize the image. A careful intensity calibration will enable the data to be analysed in terms of limb/disk intensity ratios, and absolute intensities. The present paper presents a full identification of the spectra, which includes a number of intersystem transitions, notably in iron ions. (auth)

4271 THEORETICAL PICTURE OF SUN STILL EVOLVING. Elson, B. M. Aviat. Week Space Technol.; 100: 63-65; 69; 71-75; 77(14 Jan 1974).

Although the Sun is a completely gaseous body, conditions at different distances from the center are so different that it is convenient to think of it as consisting of four different regions—interior, photosphere, chromosphere, and corona. The photosphere is the thin visible "surface" of the Sun, a region where visible light is emitted, unimpeded by the overlying gases. The interior of the Sun is the site of its nuclear reactor and the source of its magnetic fields and mechanical and magnetohydrodynamic wave actions. Above the photosphere is the chromosphere and beyond this, the corona, the two components of the Sun's usually invisible atmosphere. Various aspects of the phenomena are discussed in detail, and attention is given to sunspots, magnetic fields, flare occurrence, and x rays. (IAA)

4272 MODEL OF THE SOLAR CONVECTION ZONE. Spruit, H. C. (Astronomical Inst., Utrecht). Solar Phys.; 34: No. 2, 277-290(Feb 1974).

A model of the convection zone is presented which matches an empirical model atmosphere (HSRA) and an interior model. A mixing length formalism containing four adjustable parameters is used. Thermodynamical considerations provide limits on two of these parameters. The average temperature–pressure relation depends on two or three combinations of the four parameters. Observational information on the structure of the outermost layers of the convection zone, and the value of the solar radius limit the range of possible parameter combinations. It is shown that in spite of the remaining freedom of choice of the parameters, the mean temperature–pressure relation is fixed well by these data. The reality of a small density inversion in the HSRA model is investigated. The discrepancy between the present model and a solar model by Mullan (1971) is discussed briefly. (auth)

4273 DETERMINATION OF THE VELOCITY AMPLITUDE OF THE TOTAL PHOTOSPHERIC MOTION FIELD. I. The Use of the Weak and Moderately Weak Lines. Kondrashova, N. N.; Gurtovenko, E. A. (Astronomical Observatory, Kiev). Solar Phys.; 34: No. 2, 291-298(Feb 1974).

By the analysis of the profiles of 20 weak lines observed at five center-to-limb positions on the solar disk, radial and tangential components of the velocity amplitude of the photospheric motion field are derived in the range of optical depth $-3.0 \leq \lg\tau_5 \leq +0.5$. (auth)

4274 STUDIES OF GRANULAR VELOCITIES. V. The Height Dependence of the Granular Doppler Shifts. Mattig, W.; Schlebbe, H. (Fraunhofer Institut, Freiburg I. B.). Solar Phys.; 34: No. 2, 299-301(Feb 1974).

In Papers II (Mehltretter, 1971) and IV (Mattig and Nesis, 1974) of this series it was established, by comparing measurements of velocity fluctuations in the core and in the wings of single Fraunhofer lines, that the granular velocity component decreases with height in the photosphere. On the basis of new observations in the wavelength interval λλ6490 to 6500 Å, taken with the Domeless Coudé Refractor in Anacapri, on July 27, 1971, an attempt is made to confirm these findings by using lines of different strength. The observations were taken on Kodak IV-E film with 7 s and 10 s exposure time, the dispersion being 6.9 mm $Å^{-1}$, the slit width 0.6″, and the slit length 120″. (WDM)

4275 DETERMINATION OF ELECTRON TEMPERATURE OF QUIESCENT PROMINENCES BY HYDROGEN LINES. Morozhenko, N. N. (Astronomical Observatory, Kiev). Solar Phys.; 34: No. 2, 303-308(Feb 1974).

In order to determine the electron temperature T_e of quiescent prominences the equation of hydrogen ionization equilibrium and the condition of detailed balance in Lα were used. Used in the calculations are values of the populations of the upper levels of hydrogen N_i ($i \geq 2$ not less than 6) and of the emission measure N^+n_e derived from observation. The emission measure is determined from the observed values of the populations of the upper levels for the given T_e by graphical extrapolation of the Saha–Boltzmann formula. Calculations were carried out for 21 prominences of different brightness. The values of the electron temperatures had a scattering within the observation and processing error range. It is suggested that the electron temperatures of all the prominences are equal and are close to 7300 K. (auth)

4276 NONTHERMAL LINE BROADENING IN THE SOLAR CHROMOSPHERE. Fosbury, R. A. E. (Royal Greenwich Observatory, Sussex, Eng.). Solar Phys.; 34: No. 2, 309-311(Feb 1974).

In an investigation of observed line widths in stellar chromospheres (Fosbury, 1973), it was pointed out that the change in broadening velocity with height, deduced from the widths of different lines, could be related to the dissipation of the mechanical energy flux which supplies the radiative losses from this atmospheric region. This assumed that the flux manifest itself as small scale motions which act to increase the width of the profile of the line absorption coefficient in a manner analogous to classical microturbulence. It can now further be shown that if it is assumed that these radiative losses from the low and middle solar chromosphere are supplied by a spectrum of acoustic waves of relatively high frequency (such that the wavelengths are smaller than the width of the line contribution functions), then a velocity amplitude-height profile can be deduced which is in good agreement with that which is required to explain the profiles of the Ca II and Mg II resonance line emission cores. The purpose of this note is to present this v(h) curve and thus take a first step in the removal of another free parameter in chromospheric line profile computations. (WDM)

4277 INTENSITY RATIOS OF HELIUM AND HYDROGEN LINES IN QUIESCENT PROMINENCES. Morozhenko, N. N. (Astronomical Observatory, Kiev). Solar Phys.; 34: No. 2, 313-322(Feb 1974).

Observations of the lines He I λ 3888 and H8 in 80 quiescent prominences by the author, and in other prominences by Kubota et al. (1972) and Morozhenko (1971), were used to derive the dependences of I(3888)/I(H8) on I(H8), N_{2^3S} on τ_0(H), and N^+n_e on τ_0(H). The equations of ionization equilibrium and triplet system steady state for a helium atom (27 levels and continuum were considered) were solved together with the radiation transfer equation in the helium Lyman continuum. As given $n_e(\tau)$ distribution with depth and T_e = 7500 K were assumed. The 2^3S level population N_{2^3S}, helium emission measure N^+n_e and the intensity ratios of the He I λ 3888 and H8 lines were calculated and compared with observation. The figures show that in bright prominences the observed values of N_{2^3S} and N^+n_e are systematically higher than the calculated ones. These deviations cannot be eliminated by decreasing n_e. One can make the calculations and observations agree for bright prominences by increasing the uv radiation which penetrates into the prominence. (auth)

4278 THEORETICAL MODEL OF FLARES AND PROMINENCES. I. Evaporating Flare Model. Hirayama, T. (Tokyo Astronomical Observatory, Mitaka, Japan). Solar Phys.; 34: No. 2, 323-338(Feb 1974).

A theoretical model of flare which explains observed quantities in Hα, euv, soft x-ray, and flare-associated solar wind is presented. It is assumed that large mass observed in the soft x-ray flare and the solar wind comes from the chromosphere by the process like evaporation while flare is in progress. From mass and pressure balance in the chromosphere and the corona, the high temperature in the soft x-ray flare is shown to be attained by the larger mass loss to the solar wind compared with the mass remained in the corona, in accord with observations. The total energy of 10^{32} erg, the electron density of $10^{13.5}$ cm^{-3} in Hα flare, the temperature of the x-ray flare of $10^{7.3}$ K and the time to attain maximum Hα brightness (600 s) are derived consistent with observations. It is shown that the top height of the Hα flare is located about 1000 km lower than that of the active chromosphere because of evaporation. So-called limb flares are assigned to either post-flare loops, surges or rising prominences. The observed small thickness of the Hα flare is interpreted by free streaming and/or heat conduction. Applications are suggested to explain the maximum temperature of a coronal condensation and the formation of quiescent prominences. (auth)

4279 THEORETICAL CHROMOSPHERIC FLARE SPECTRA. II. Hydrogen Equilibrium for Brown's (1973) Models For Heating by Nonthermal Electrons. Canfield, R. C. (Air Force Cambridge Research Labs., Sunspot, NM). Solar Phys.; 34: No. 2, 339-348(Feb 1974).

Simultaneous solutions were obtained of the equations of radiative transfer and statistical equilibrium for hydrogen excitation and ionization. The model atom included Lα, Lβ, Balmer-α, and

the Lyman, Balmer and Paschen continua. The model atmospheres were those of Brown (1973) representing the effects of heating by nonthermal electrons on the Harvard–Smithsonian Reference Atmosphere. The spectral and atmospheric properties of Brown's (1973) models characterize a flare of strength markedly less than a typical large flare, but within the range observed. The Balmer-α profiles are self-reversed, but to a much lesser extent than those of Paper I. However, Brown (1973) uses a radiative-loss estimate that is more than an order of magnitude too large in the region of Balmer-α formation. Until this problem is remedied one cannot meaningfully compare the computed profiles to observations. (auth)

4280 SPATIAL DISTRIBUTION OF SOFT X-RAY AND EUV EMISSION ASSOCIATED WITH A CHROMOSPHERIC FLARE OF IMPORTANCE 1B ON AUGUST 2, 1972. Neupert, W. M.; Thomas, R. J.; Chapman, R. D. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 34: No. 2, 349-375(Feb 1974).

Soft x-ray and extreme ultraviolet spectroheliographs carried by the OSO-7 (Orbiting Solar Observatory) have been used to record the development of xuv emission associated with a flare of importance 1b on August 2, 1972. Spatial resolution was 20" and spectral resolution was adequate to select emission lines originating within well-defined ranges of electron temperature between 5×10^4 and 30×10^6 K. The data show that heating only the pre-existing coronal material adjacent to the flare site cannot account for the soft x-ray emission measure observed during the event. The flare emission originating at $T_e \leq 2.3 \times 10^6$ K exhibits an impulsive component coincident with an impulsive microwave event. This radiation appears to coincide spatially with Hα radiation emitted at that time and is centered on the neutral line separating magnetic fields of opposite polarity. One soft x-ray-emitting feature, estimated to have an initial electron temperature of 2 to 10×10^6 K, forms during the impulsive phase immediately over the Hα flare. A second, arch-like feature observed at wavelengths near 1.9 Å and estimated to have $T_e \approx 30 \times 10^6$ K is located approximately 35,000 km above the Hα event. Both regions have lengths of about 27,000 km but transverse dimensions small compared to the spatial resolution of the spectroheliograph, i.e., less than 14,000 km. The region with highest electron temperature exhibits the greatest stability in position. This region cools to approximately 10×10^6 K in 6 to 12 min which is compatible with cooling by conduction to the chromosphere. The best association with a dark surge is found in an emission line of Fe XIV. (auth)

4281 CORRELATION BETWEEN TIME-OVERLAPPING SOLAR FLARES AND THE RELEASE OF ENERGETIC PARTICLES. Simnett, G. M. (Univ. of California, Riverside). Solar Phys.; 34: No. 2, 377-391(Feb 1974).

The origin of a large co-rotating solar particle event in August, 1970, is discussed. Proton data from spacecraft at five widely separated heliocentric longitudes are used to identify two distinct release points which are over 100° apart in solar longitude. Optical flare data shows a high incidence of time-overlapping flares between plage regions close to the two release points, indicating a good connection between them. Unusual x-ray and radio emissions are also observed from these regions. The spectrum of the relativistic electrons in the co-rotating particle event is represented by a power law with index $\gamma \approx -4$, considerably steeper than that usually observed from a solar flare. It is concluded that there is a large magnetic loop structure connecting points over 100° apart on the Sun which is able to trap energetic protons and electrons from an earlier solar flare. Subsequent release of these particles establishes an intense, long-lived co-rotating event. (auth)

4282 TOWARDS A THEORY FOR TYPE III SOLAR RADIO BURSTS. II. The Radiation Source. Smith, D. F. (National Center for Atmospheric Research, Boulder, CO). Solar Phys.; 34: No. 2, 393-411(Feb 1974).

The mechanisms for the transformation of plasma waves into radiation near the fundamental and second harmonic of the plasma frequency are reviewed and equations are given for both the emission and absorption coefficients for these mechanisms. Near the fundamental the process is the scattering of plasma waves on the polarization clouds of ions and the absorption coefficient can be negative, i.e., the radiation can be amplified. Near the second harmonic the process is the combination of two excited plasma waves for which the absorption coefficient can only be positive. These results are applied to construct models of the radiation source for Type III solar radio bursts both at high frequencies where the fundamental is dominant and at low frequencies where the second harmonic is dominant using two model plasma wave spectra, one being one-dimensional, the other isotropic. At high frequencies second harmonic radiation is used to determine the source area for a given energy density in plasma waves W_p. The source size and W_p are determined uniquely for a given plasma wave spectrum by tracing rays in a model source taking into account amplification of the fundamental. The results for a strong source at the 80 MHz plasma level with a ratio of emissivities of the fundamental to second harmonic $P(\omega_p)/P(2\omega_p) \approx 10$ are that the source with a one-dimensional plasma wave spectrum is about 14,000 km in diameter and $W_p \approx 10^{-6.52}$ erg cm^{-3}, and the source with an isotropic distribution of plasma waves is about 200 km in diameter and $W_p \approx 10^{-6.3}$ erg cm^{-3}. It is shown that at low frequencies, where amplification of the fundamental is no longer possible, second harmonic radiation must be dominant and thus very little information about the source can be obtained from the radiation. (auth)

4283 KILOMETER-WAVE TYPE III BURSTS: HARMONIC EMISSION REVEALED BY DIRECTION AND TIME OF ARRIVAL. Alvarez, H.; Haddock, F. T.; Potter, W. H. (Univ. of Michigan, Ann Arbor). Solar Phys.; 34: No. 2, 413-420(Feb 1974).

A Type III solar burst was observed at seven frequencies between 3.5 MHz and 80 kHz by the Michigan experiment aboard the IMP-6 satellite. From the data one can determine burst direction-of-arrival as well as time-of-arrival. These quantities are predicted using simple models whose parameters are varied to obtain a good fit to the observations. It is found that between 3.5 MHz and 230 kHz the observed radiation was emitted at the fundamental of the local plasma frequency while below 230 kHz it was emitted at the second harmonic. The exciter particles that produced the burst onset and burst peak have velocities of 0.27 and 0.12, respectively, in units of the velocity of light. (auth)

4284 COMMENTS ON "NEUTRALIZATION AND STABILIZATION OF PARTICLE STREAMS IN THE CORONA AND TYPE III RADIO BURSTS" BY DEAN F. SMITH. Melrose, D. B. (CSIRO, Sydney). Solar Phys.; 34: No. 2, 421-425(Feb 1974).

Electron streams which excite Type III bursts experience a negligible energy loss in accelerating a return current. Furthermore the plasma oscillations generated as the return current turns on and off are too weak to be of significance as a source of the observed radiation. (auth)

4285 SUGGESTED EXPLANATION FOR FINE STRUCTURES OBSERVED IN SOME WIDE-BAND BURSTS. Sy, W. N. C. (CSIRO, Sydney). Solar Phys.; 34: No. 2, 427-431(Feb 1974).

Plasma radiation arising from nonlinear coupling of upper hybrid plasma waves and Bernstein waves is examined as a possible explanation (Rosenberg, 1972) for the fine structures observed in some wide-band solar radio bursts. This radiation is found to be weakly polarized and therefore it cannot account for the fine structures, which are strongly polarized. The difficulties encountered in explaining several bands of radiation at comparable intensities are indicated. (auth)

4286 DECAMETER TYPE IV BURSTS ASSOCIATED WITH CORONAL TRANSIENTS. Gergely, T. E.; Kundu, M. R. (Univ. of Maryland, College Park). Solar Phys.; 34: No. 2, 433-446 (Feb 1974).

The characteristics of four moving Type IV bursts, observed with the 65 to 20 MHz swept-frequency interferometer of the Clark Lake Radio Observatory are discussed. All four bursts were associated with depletions in the electron content of the white light corona. Characteristics of the bursts are not unique, i.e., they differ in source size, structure, duration and their association with other radio bursts. Following Smerd and Dulk (1971) it is believed that a shock wave, moving out from the flare site is responsible for the expansion of a magnetic arch or the ejection of a plasmoid which is observed as the usual Type IV burst. Behind the shock wave, the compressed coronal gas moves outward, and as it expands it causes a depletion of electrons in the inner corona. After the passage of the shock wave, sometimes the coronal magnetic field structure is restored to its initial situation, as evidenced by the observation of homologous transients. (auth)

4287 CORONAL TRANSIENT OF JUNE 16, 1972. Koomen, M. (Naval Research Lab., Washington, DC); Howard, R.; Hansen, R.; Hansen, S. Solar Phys.; 34: No. 2, 447-452(Feb 1974).

On June 16, 1972, the Naval Research Laboratory's coronagraph aboard OSO-7 tracked a huge coronal cloud moving outward from the Sun. Concurrent observations of the inner corona made by the High Altitude Observatory at Mauna Loa showed bifurcation of the underlying coronal structure. Together, these observations can be interpreted as evidence for the stretching of the closed fields into a "magnetic bottle", extending to at least eight radii from the center of the Sun. (auth)

4288 CORONAL DISTURBANCES. II. The Fast Rearrangement of Coronal Magnetic Fields. Wagner, W. J. (Sacramento Peak Observatory, Sunspot, NM); Hansen, R. T.; Hansen, S. F. Solar Phys.; 34: No. 2, 453-459(Feb 1974).

A fast coronal transient event was observed simultaneously on February 17, 1972 by the Sacramento Peak Observatory 6-in. λ5303 filter coronagraph and the High Altitude Observatory K-coronameter. The rapid opening of green line structure cospatial with the disappearance of a white light streamer is interpreted as material motion of iron ions and electrons. Together with the subsequent two-fold increase in K-corona brightness in an adjacent region, this is taken as evidence of a transference of electrons to a new streamer in a realignment of magnetic flux tubes accompanying a flare. (auth)

4289 CORONAL MAGNETIC STRUCTURE AT A SOLAR SECTOR BOUNDARY. Wilcox, J. M.; Svalgaard, L. (Stanford Univ., CA). Solar Phys.; 34: No. 2, 461-470(Feb 1974).

The persistent large-scale coronal magnetic structure associated with a sector boundary appears to consist of a magnetic arcade loop structure extending from one solar polar region to the other in approximately the north–south direction. This structure was inferred from computed coronal magnetic field maps for days on which a stable magnetic sector boundary was near central meridian, based on an interplanetary sector boundary observed to recur during much of 1968 and 1969. (auth)

4290 ELEVEN-YEARS INVERSION OF THE GREEN CORONA EMISSION. Antonucci, E. (Stanford Univ., CA). Solar Phys.; 34: No. 2, 471-476(Feb 1974).

A cross-correlation analysis of coronal green line intensity (5303 Å) and interplanetary magnetic field polarity for the period 1947–1970 shows that the coronal features are organized in a constant pattern with respect to the 4-sector structure through the solar cycle. A sudden inversion of the coronal pattern with respect to the sector structure takes place at the solar minima. The high emission regions of the green corona are located near the solar magnetic sector boundaries having polarities (–,+), (+,–), (–,+) during cycles 18, 19, 20 respectively in the northern hemisphere, and (+,–), (–,+), (+,–) in the southern hemisphere. (auth)

4291 ASTROPHYSICS. pp 681-686 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Six papers on nuclear reactions of importance in astrophysics are presented. The subjects are the $^{3}He(^{3}He,2p)^{4}He$ and $^{12}C(\alpha,\gamma)^{16}O$ reactions, r-process nucleosynthesis, superallowed Fermi β decays and the vector weak interaction, and the decays of the proton-rich nuclides ^{72}Kr and ^{73}Kr. (RWR)

4292 SOLAR NEUTRINOS. Bahcall, J. N. pp 681-716 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The three sections concerning cross sections, solar models, and a summary of the methods of detection are a slightly updated version of a review article by Bahcall and Sears (Annual Review of Astronomy and Astrophysics, Vol. 10, pg. 25, 1972). The last two sections include opinions on what are the likely origins of the discrepancy between theory and observation and on what one should do next theoretically and experimentally. (WDM)

4293 SEARCH OF PERTURBATIONS FROM PROMINENCE MOVING IN CHROMOSPHERE. Mamedov, S. G.; Zhilin, V. I. Tsirk. Shemakh. Astrofiz. Observ.; No. 12, 16-18(Dec 1971). (In Russian).

4294 ELONGATION OF SOLAR GRANULAE. Kerimbekov, M. B. Tsirk. Shemakh. Astrofiz. Observ.; No. 4, 11-12(Apr 1972). (In Russian).

4295 2s–2p TRANSITIONS IN THE SPECTRA OF Ca XVII AND Ti XIX. Goldsmith, S. (Tel Aviv Univ., Ramat Aviv, Israel); Oren, L.; Crooker, A. M.; Cohen, L. Astrophys. J.; 184: No. 3, 1021-1026(15 Sep 1973).

The spectra of Ca XVII and Ti XIX in the region 160 to 360 Å are presented for the first time. Lines corresponding to the transition arrays $2s^2-2s2p$ and $2s2p-2p^2$ are identified and classified. Extrapolation procedures are described in detail. (auth)

4296 INTERACTION OF MAGNETOGRAVITATIONAL WAVES AND SOME APPLICATIONS TO THE PHYSICS OF THE SOLAR ATMOSPHERE. Brengauz, V. D. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 192-203 (1974). (In Russian).

The interaction between magneto-sound waves in the inhomogeneous isothermal atmosphere when a homogeneous magnetic field H_0 is parallel to acceleration of the gravity force g is examined. Expressions are derived for the transformation and reflection coefficients. The height interval is determined in which the different type waves interact more effectively. These heights determine the region of violating the geometrical optics approximation. The estimations are made for the conditions existing in the solar chromosphere. (auth)

Galaxies

Refer also to abstracts 4164 and 5117.

4297 A REEXAMINATION OF THE MEAN H I DENSITY ALONG THE HUBBLE SEQUENCE. Kellman, S.A.; Black, D.C. (Theoretical Studies Branch, Ames Research Center, Moffett Field, California). Astrophys. J. 184: No. 3, 753-756 (15 Sept 1973).

Using the 21-cm galaxy surveys of both Roberts and Bottinelli, it is shown that the mean H I space density is at most a weak function of galactic type along the limited Hubble sequence Sb–Irr. On this basis, it is concluded, contrary to previous thought, that the mean H I density is not the large-scale galactic parameter which determines the morphological characteristics of galaxies. (auth)

4298 A SEARCH FOR INTERSTELLAR ACRYLONITRILE, PYRIMIDINE, AND PYRIDINE. Simon, M.N. (Department of Biology, Brookhaven National Laboratory, Upton, New York); Simon, M. Astrophys. J. 184: No. 3, 757-761 (15 Sept 1973).

We report the results of a negative search at 6 mm for acrylonitrile (expected as a hydrogenation product of cyanoacetylene) and the ring compounds pyrimidine, and pyridine. The estimated upper bound on the column density of acrylonitrile in Sgr B2 is a few percent that of cyanoacetylene. The implications of this for the effectiveness of hydrogenation reactions on the surfaces of grains in the molecular clouds are discussed. (auth)

4299 CONCERNING THE FORMS OF THE VELOCITY-DISTANCE RELATION CLUSTERS. Bautz, L.P. (Dearborn Observatory, Northwestern University, Evanston, Illinois); Abell, G.O. Astrophys. J. 184: No. 3, 709-718 (15 Sept 1973).

"Brightest galaxy" form types are given for 14 Humason-Mayall-Sandage clusters, for five other clusters with $z<0.2$, and for the three known clusters beyond $z=0.2$. A preliminary calibration of the difference in apparent magnitude between the brightest galaxy and the break in the cluster luminosity function is proposed for clusters of various richnesses and form types. This relation is used to determine a revised velocity-apparent-magnitude diagram based on matching the cluster luminosity functions. The determination of the value of q_0 is shown to be very sensitive to the adopted relation. (auth)

4300 IONIZATION RATE IN INTERSTELLAR CLOUDS. Penston, M. V. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 21P-23P(Feb 1974).

Recent ultraviolet observations suggest that the heating rate in interstellar clouds greatly exceeds that estimated hitherto. (auth)

4301 SPECTRUM OF THE GALACTIC NON-THERMAL BACKGROUND RADIATION. I. Observations at 151.5 and 408 MHz. Sironi, G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 345-353(Feb 1974).

Observations of the galactic radio background radiation have been carried out at 151.5 and 408 MHz with dipole arrays having a beamwidth of 17° × 12°, geometrically scaled from those used at 17.5 and 81.5 MHz by Bridle (Mon. Not. R. Astr. Soc.; 136:219 (1967)) for similar measurements. The results indicate that between 17.5 and 408 MHz the galactic spectral index is frequency dependent and its value changes over the sky, the spectrum becoming steeper toward the region of minimum sky brightness and flatter toward the local spiral arm. Evidence for the existence of two or more components of the galactic radio emission is suggested. (auth)

4302 SPECTRUM OF THE GALACTIC NON-THERMAL BACKGROUND RADIATION. II. Observations at 408, 610, and 1407 MHz. Webster, A. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 355-371(Feb 1974).

Between 408, 610, and 1407 MHz the mean differential temperature spectral index of the galactic nonthermal radiation is found to be close to 2.80, although the exact value varies with direction.

Several regions with anomalous spectra are associated with previously-known features of the continuum background. (auth)

4303 OBSERVATIONS OF CYGNUS A WITH THE 5-km TELESCOPE. Hargrave, P. J.; Ryle, M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 305-327(Feb 1974).

Maps of the distribution of radio brightness and polarization in Cygnus A at 5 GHz have been made with an angular resolution of $2.0'' \times 3.1''$ arc. These show details of the structure of the compact features in the parts of the source most distant from the optical galaxy, as well as the structure and particularly the strong polarization in parts of the extensive tails. Some limited observations at 15 GHz with a resolution of 0.4'' arc have been used to define more closely the shape of the compact components. A weak central source <1.5 kpc in diameter has been found which lies between the two optical "nuclei" in photographs of the central region of the galaxy. On the assumption of equipartition between relativistic electrons and magnetic field, and from a study of the spectral distribution, it is concluded that there must be a continous replenishment of energetic electrons within each of the two main compact components of the source, representing an energy supply of $\sim 10^{45}$ erg s^{-1}. These electrons must diffuse out into the extensive tail regions on a time scale $\lesssim 4 \times 10^4$ yr and probably provide the entire energy requirements of these regions; the subsequent radiation losses provide an explanation of the change in the spectral index of the integrated emission at ~1 GHz. The evidence now available is inconsistent with several of the physical models which have been proposed. The models most likely to provide a satisfactory explanation of the details observed seem to be those in which energy is continually transported to the components from the nucleus in the form of energetic particles or low-frequency waves. (auth)

4304 DYNAMICAL MODELS FOR THE FORMATION AND EVOLUTION OF SPHERICAL GALAXIES. Larson, R. B. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 585-616(Mar 1974).

Models for the collapse of spherical protogalaxies have been computed using a two-fluid hydrodynamical approach to treat both the gas and the stars. The effects of gaseous energy losses, star formation, stellar mass loss and heavy element (Z) production are included and are followed over the lifetime of the galaxy. With reasonable choices for the parameters, the models reproduce well the observed structure of NGC 3379 and other nearly spherical galaxies. The observed Z gradients in elliptical galaxies are qualitatively reproduced, and metal-poor stars are very rare in the inner regions of the models, as in the solar vicinity. Star formation continues for the longest time in the nucleus, owing to the continuing condensation of residual gas toward the center, and in some circumstances the infall of the last remnants of the initial protocloud may continue to support significant star formation in a galaxy even after 10^{10}yr. Various characteristics of the models suggest that the quasar phenomenon may be identifiable with the formation of the nucleus of a giant elliptical galaxy. (auth)

4305 STRUCTURE OF BARRED STELLAR SYSTEMS. Hunter, C. (Florida State Univ., Tallahassee). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 633-648(Mar 1974).

Some self-consistent stellar dynamic models of rotating barred systems due to Freeman are analyzed. The complete range of models is delineated and their important nondimensional properties are plotted graphically. The evolution of these models as they lose mass is not always as described by Freeman in that they may become less rather than more circular. The models, together with some new solutions for uniform ellipsoids, appear to be the only self-consistent stellar systems possible with the assumed mass distributions and potentials. Most of the new ellipsoidal solutions are unphysical because they require orbits populated with negative numbers of stars. (auth)

4306 DETECTION OF FORMALDEHYDE IN EXTERNAL GALAXIES. Gardner, F. F.; Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Nature (London); 247: No. 5442, 526-527(22 Feb 1974).

The detection of HCHO absorption in the edge-on spiral galaxies NGC 253 and 4945 is reported; this is stated to be the first evidence of this molecule in external galaxies. The observations were made in November 1973 with the Parkes 64m telescope equipped with a 6cm cryogenic parametric amplifier and a 512 channel autocorrelator. The HCHO spectra obtained are shown and discussed. (UK)

4307 MICROWAVE RADIATION FROM MOLECULES IN SPACE. Schwartz, P. P. (Naval Research Lab., Washington, DC). pp 129-132 of NEREM 72. Newton, MA; Institute of Electrical and Electronics Engineers, Inc. (1972).

From northeast electronics research and engineering meeting; Boston, MA (30 Oct 1972).

Recent observations of microwave radiation from the interstellar medium are briefly reviewed in terms of current knowledge on the chemical composition, distribution, and excitation of interstellar molecules. Problems encountered in observations of the frequency structure, intensity, and polarization of the emissions are outlined to demonstrate the requirements for radiometers, filters, and antennas. (IAA)

4308 UPPER LIMIT OF THE COLLAPSED STARS NUMBER IN THE GALAXY. Guseinov, O. Kh.; Novruzova, Kh. I. Tsirk. Shemakh. Astrofiz. Observ.; No. 1, 10-13(Jan 1973). (In Russian).

4309 NUMBER OF WHITE DWARFS IN THE GALAXY. Seidov, Z. F. Tsirk. Shemakh. Astrofiz. Observ.; No. 2, 3-7 (Feb 1973). (In Russian).

4310 INTERSTELLAR SULFUR MONOXIDE. Gottlieb, C. A.; Ball, J. A. (Harvard College Observatory, Cambridge, MA). Astrophys. J.; 184: No. 2, L59-L64(1 Sep 1973).

Interstellar emission was observed from the $J_K = 3_2 \rightarrow 2_1$ (99.3 GHz) and the $4_3 \rightarrow 3_2$ (138.2 GHz) transitions of sulfur monoxide ($^{32}S^{16}O$)—a new interstellar molecule. SO was found in seven galactic sources and is the first $^3\Sigma$ molecule detected in space by radio astronomical techniques. Statistical-equilibrium calculations were performed to derive column densities and to predict the relative strengths of other SO transitions accessible at millimeter wavelengths. (auth)

4311 ANGULAR MOMENTUM OF SPIRAL GALAXIES. II. Detailed Models and Correlations for 17 Galaxies. Nordsieck, K. H. (Univ. of California, Santa Cruz). Astrophys. J.; 184: No. 3, 735-751(15 Sep 1973).

The rotation curve analysis method of Paper I has been used to calculate the mass–surface-density distribution in 17 spiral galaxies. The assumption of constant M/L ratio in the outer disk region is verified, which allows the use of an exponential density extrapolation to estimate the total mass, kinetic energy, and angular momentum of these systems, along with their probable errors. The mass and angular momentum are shown to be completely specified by two independent observable parameters, a characteristic velocity and radius. However, it can be shown statistically that observational errors in these quantities can lead to a very tight power-law relationship between the mass and angular momentum, which may have no connection with the "true" relationship. The sample of the present paper and of similar investigations by previous authors all lead to this same spurious power law. Comparison, instead, of the characteristic radii and velocities of galaxies is more informative and less subject to statistical bias. There is a good correlation between the M/L ratio and the B–V color or Yerkes type seen in this sample, but no significant correlation with the morphological type. Similar correlations using the mass or angular momentum are noted, but these are not physically significant because observational selection of very luminous galaxies creates a false correlation between mass and M/L. (auth)

4312 ANGULAR MOMENTUM OF SPIRAL GALAXIES. I. Methods of Rotation-Curve Analysis. Nordsieck, K. H. (Univ. of California, Santa Cruz). Astrophys. J.; 184: No. 3, 719-733 (15 Sep 1973).

The disk method of rotation-curve analysis (Toomre) is more suitable than older "spheroid" methods for computing the angular momentum and mass distribution in spiral galaxies because (a) no fitting of the velocity curve is necessary, (b) the mass surface density, which is analogous to the surface brightness, is computed directly, and (c) less numerical labor is involved. The mass surface density probably drops off exponentially with radius in faint regions where there exists no rotation information, since the brightness distribution there is exponential and the M/L ratio does not vary rapidly. The rapid descent of the surface density allows a good estimate of the total angular momentum to be obtained from existing rotation information and photometry for a number of galaxies. Formulae that are suitable for numerical calculations by these methods are presented. Simple mathematical models that represent the luminosity distribution in the spheroidal central bulges of spirals and in elliptical galaxies are developed. They demonstrate that the existence of spheroidal subsystems in spirals does not affect the derived angular momentum, but may be important for the total (turbulent plus rotational) kinetic energy. (auth)

4313 INVESTIGATION OF THE CANCER CLUSTER OF GALAXIES. Tifft, W. G.; Jewsbury, C. P.; Sargent, T. A. (Univ. of Arizona, Tucson). Astrophys. J.; 185: No. 1, 115-119(1 Oct 1973).

Redshifts for nine galaxies in the center of the Cancer cluster are reported. Four show emission lines and one of these galaxies is a high-excitation peculiar object showing a distorted dust lane and "jet" or edge-on disk structure. A conventional virial-theorem analysis of the cluster indicates a total cluster mass near 10^{14} $M_\odot$ and suggests that the usual instability problem found in galaxy clusters is present. (auth)

4314 E_1-E_2 LABELING OF ENERGY LEVELS AND THE ANOMALOUS EXCITATION OF INTERSTELLAR METHANOL. Lees, R. M. (Univ. of New Brunswick, Fredericton). Astrophys. J.; 184: No. 3, 763-771(15 Sep 1973).

The notation for torsion–rotation energy levels of methanol is reviewed, and it is emphasized that the levels previously labeled as E_1 and E_2 do not form separate noninterconverting stacks when both positive and negative values of the rotational quantum number k are taken into account. Dropping of the E_1-E_2 notation in favor of the use of a signed quantum number k is therefore recommended. Experiments are described demonstrating explicitly the transfer of molecules from E_1 to E_2 levels by one or more allowed electric-dipole transitions. The implications of E_1-E_2 conversion for anomalous excitation of interstellar methanol are discussed, and it is pointed out that if $\Delta k = 0$ collision-induced transitions are preferred strongly in CH_3OH-H_2 collisions, as was proposed from microwave double-resonance studies, then it is likely that the $5_{-1} \rightarrow 4_0$ and $4_{-1} \rightarrow 3_0$ E transitions detected in Sgr B2 are inverted. (auth)

4315 21-CM OBSERVATIONS OF A CROSS SECTION OF DISTANT SPIRAL ARMS. Verschuur, G. L. (National Radio Astronomy Observatory, Charlottesville, VA). Astron. J; 78: No. 9, 898-912(Nov 1973).

High-resolution observations of neutral hydrogen in several spiral arms 16 kpc or more from the Sun reveal very interesting aspects of the distribution of clouds in those arms and the nature of the bending of the galactic plane. The distant clouds to which the present experiment is sensitive have typical masses of 10^5 $M_\odot$. Holes with sizes of a hundred parsec across appear in the distribution of interstellar HI. The galactic plane shows the bending to several kpc above the plane at distances of 16 kpc from the galactic center. Individual clouds are found up to ≥3 kpc above the plane in the region studied here and the clouds at lower z-distances often have the form of tongues or filaments of matter protruding from the galactic disk. (auth)

4316 DIFFUSE INTERSTELLAR BANDS: A CORRELATION ANALYSIS. Snow, T. P. Jr. (Univ. of Washington, Seattle). Astron. J.; 78: No. 9, 913-923(Nov 1973).

Data on six of the unidentified diffuse interstellar bands for a large number of stars were obtained. By the use of statistical techniques for the analysis of linear correlations where error is assumed to exist in both dimensions, quantitative basis was found for the following conclusions: that both the 4430 and 5780 Å diffuse features are probably formed by interstellar dust, but do not correlate perfectly with reddening or with each other, implying that they are produced by different constituents of the grains; that all six of the bands included here are very unlikely to be carried by a common agent; that the correlations between diffuse band strengths and interstellar polarization and NaI absorption is poor, even in a direction in the sky where the interstellar medium appears very uniform; and that the apparent weakness of the diffuse bands with respect to reddening in emission-line stars is due to peculiar local reddening effects and not to peculiar diffuse band absorption. Finally, the implications of these findings for various suggested diffuse band sources are discussed. (auth)

4317 FAINT O–B3 STARS IN A REGION IN NORMA. Muzzio, J. C.; McCarthy, C. C. (Steward Observatory, Tucson, AZ). Astron. J.; 78: No. 9, 924-928(Nov 1973).

The results of a search for faint blue stars in a field in Norma by means of UBV photographic photometry are presented. The field is centered at $l = 328.0°$, $b = -0.8°$; $\alpha(1975) = 15^h\ 55^m\ 0.4$, $\delta(1975) = -54°16'$, and covers an area of 2260 sq min of arc. Table I shows that there are within this area 125 stars with derived spectral types B3 or earlier, of which only 11 were previously known. The magnitude range of the survey is: $9.0 < V < 15.4$. There are 46 newly discovered stars of spectral type B2 or earlier, from whose study it is estimated that a total visual absorption of about 3 mag sets in within 2 kpc from the Sun and does not increase significantly to a distance of at least 5 kpc from the Sun. The distribution of the stars of spectral type B2 or earlier by distance modulus suggests the existence of two spiral features in this direction. These are tentatively interpreted as related to the Saggitarius arm (near 2.5 kpc) and the Norma–Scutum arm (beyond 5 kpc from the Sun). (auth)

4318 RECENT EVOLUTIONARY HISTORY OF THE CLUSTER SYSTEM OF THE LARGE MAGELLANIC CLOUD. Hodge, P. W. (Univ. of Washington, Seattle). Astron. J.; 78: No. 9, 807-810(Nov 1973).

Using estimates of the magnitudes of the brightest stars of star clusters of the LMC, the distribution of clusters as a function of age over the entire face of the Cloud was established. Ages were estimated for the 509 youngest clusters, allowing exploration of the spatial pattern of cluster formation at various times in the recent history of the galaxy. The average rate of formation of clusters is 1 per 3×10^4 yr. (auth)

4319 DUST CONTINUUM IN THE ORION NEBULA. Perinotto, M.; Wurm, K. Astron. Nachr.; 293: No. 1–2, 25-31(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

Spectra of the Orion Nebula with a long slit were taken on two fast spectroscopes during the occurrence of continuous emission. The ratio between the intensities of Balmer emission and continuous emission was found to vary irregularly along the length of the slit and from position to position, the variations being generally small except at the center of the Nebula. Surface structures typical of the continuous emission and those typical of hydrogen line emission were discernible on the larger portion of the field of the Nebula, below the Balmer discontinuity as well as above hydrogen alpha in the infrared. (IAA)

4320 POSSIBLE EXISTENCE OF DUST GRAINS AT LARGE DISTANCES FROM THE GALACTIC PLANE. Schmidt, K. H. (Univ., Jena, Ger.). Astron. Nachr.; 293: No. 1–2, 11-16(1971).

From conference on interstellar dust; Jena, Germany (22 Aug 1969).

The effect of the radiation pressure of the interstellar radiation field on interstellar grains high above the galactic plane is estimated. It is shown that interstellar dust particles reaching large distances from the galactic plane are concentrated between 140 and 250 pc from the galactic plane. This result is in qualitative agreement with observations. (auth)

Cosmology

Refer also to abstracts 4126, 4299, 5117, 5288, 5298, 5302, 5322, and 5335.

4321 (IC-73-192) EARLY STAGES OF THE UNIVERSE. Sciama, D. W. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1973. 29p. (CONF-730855-1). Dep. NTIS (U. S. Sales Only) $3.50.

From 15th general assembly of the international astronomical union meeting; Sydney, Australia (21 Aug 1973).

A brief account is given of the present understanding of the early stages of the Universe. The most important problems that remain are discussed in some detail. (WDM)

4322 (MATSCIENCE-76, pp 64-77) CONFORMAL INVARIANCE AND COSMOLOGY. Lord, E. A. (Inst. of Mathematical Sciences, Madras). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

A new formulation and interpretation of Weyl's gauge-invariant geometry is given. Weyl's four-vector is treated as a Yang-Mills field for the group of conformal mappings, and the conformal transformation law of the gravitational Lagrangian is found to lead to the interpretation of the gravitational "constant" as a scalar field, as in the Brans-Dicke cosmology. It is found that the Dirac spinor does not couple to the four-vector, so that the four-vector cannot be interpreted as the electromagnetic potential. It is suggested that its role is that of a creation field in the sense of the cosmology of Hoyle and Narlikar. (auth)

4323 NUMERICAL SOLUTIONS FOR SYMMETRIC BIANCHI TYPE IX UNIVERSES. Moser, A.R.; Matzner, R.A.; Ryan, M.P. Jr. (Center for Relativity Theory, Department of Physics, The University of Texas at Austin, Austin, Texas 78712). Ann. Phys. (N.Y.) 79: No. 2, 558-579 (Aug 1973).

We find numerical solutions for symmetric Bianchi type IX universes. These numerical solutions coincide almost exactly with diagrammatic solutions found previously. (auth)

4324 FLUCTUATIONS IN THE X-RAY BACKGROUND. Scheuer, P. A. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 329-337(Feb 1974).

The fluctuations in the x-ray background at high galactic latitudes give an upper limit to the counts of extragalactic x-ray

sources near the intensity level corresponding to one source per beam width. The general mathematical relation between the source counts and the probability distribution of the resulting contribution to the fluctuations is known, and is here computed for various extrapolations of the observed source counts to fainter sources. The observed limits to background fluctuations are consistent with a uniform distribution of sources in space. (auth)

4325 LOGICAL FOUNDATION OF THE ANALYSIS OF INFINITY CONCEPT IN COSMOLOGY. Lednikov, E. E. (Inst. of Physics, Kiev). pp 198-203 of Methodological Analysis of the Theoretical and Experimental Bases of Gravitational Physics. Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Consideration of the philosophic aspects of infinity in cosmology in the light of modern theories suggests that the concept of infinity as applied in cosmology has no cosmological or logical contents. It is contended that this concept retains a logical nature only when it is treated in terms of finiteness. (IAA)

4326 ISOTROPY OF RADIO SOURCE POPULATIONS FROM COMPARISON OF NUMBER-FLUX DENSITY CURVES. Golden, L. M. (Univ. of California, Berkeley). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 383-408(Feb 1974).

To study the distribution of radio source populations with position over the sky, the 4C sky is divided into regions and the slope of the source count curve of the sources in each is computed. The isotropic nature of this distribution is shown in several ways. A recent report of an anisotropic distribution of radio sources is discussed in light of these results. In addition, the dispersion among the slopes of the source count curves is examined in terms of a hypothetical clustering of radio sources. (auth)

4327 VARIATION OF RADIO SOURCE COUNTS WITH DIRECTION, FOR THE 3CR AND 4C SURVEYS. Pearson, T. J. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 2, 249-257(Feb 1974).

In an investigation of variations with direction of the radio source counts N(S) (the number of sources in unit solid angle with flux density greater than S) for the 3CR and 4C surveys, no anisotropy has been found which is not explicable in terms of random statistical differences between limited samples of sources; in particular, there is no significant difference between the slopes of the source counts in the northern and southern galactic hemispheres. (auth)

4328 VARIATIONS IN THE PRIMORDIAL HELIUM ABUNDANCE. Gisler, G. R.; Harrison, E. R.; Rees, M. J. (Univ. of Sussex, Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 3, 663-671(Mar 1974).

It is first shown that simple temperature fluctuations of constant specific entropy do not affect the production of helium in the early Universe. This result is contrary to conclusions reached in previous work. It is then shown that curvature fluctuations, associated with temperature fluctuations and previously ignored, affect the cosmic helium abundance Y. Positive curvature fluctuations increase the expansion time and therefore reduce Y; negative curvature fluctuations on the other hand increase Y. In the case of constant specific entropy the effect of positive curvature fluctuations dominates, thus yielding a net reduction in the cosmic helium abundance. The effect is most pronounced for perturbations of scale length approximately equal to the Hubble distance when the temperature is 10^{10}K. Analytical and computational methods are used to estimate the change in Y as a function of the temperature fluctuation. In general, the net reduction in Y is small (a few percent only); but under special conditions, when specific entropy is not constant, Y can be reduced from 0.27 (the adopted unperturbed value) to approximately the value 0.21. (auth)

4329 BLACK HOLES IN STATIC ELECTROVAC SPACE-TIMES. Zum Hagen, H. M.; Robinson, D. C.; Seifert, H. J. (King's Coll., London). Gen. Relativity Gravitation; 5: No. 1, 61-72(Feb 1974).

The theorem of Israel (Commun. Math. Phys.; 8: 245 (1968)) which characterizes the Reissner-Nordström solutions as the only well behaved asymptotically flat electrovac spaces with a simple regular horizon is extended by weakening the assumptions. Critical points of the gravitational potential are not a priori excluded and the topology of the equipotential surface is not restricted. The regularity of the horizon is formulated in terms of bounds for certain geometrical quantities and the assumption of existence, in some extension, of a bifurcation surface for the horizons is not made. The possibilities of nonstatic or nonconservative electromagnetic fields in a static space-time are discussed and excluded by physical arguments. (auth)

4330 COSMIC FAR ULTRAVIOLET BACKGROUND. Davidsen, A.; Bowyer, S.; Lampton, M. (Univ. of California, Berkeley). Nature (London); 247: No. 5442, 513-516(22 Feb 1974).

It is stated that interest in the diffuse far ultraviolet background stems largely from its relevance to the view that intergalactic space may be filled with a dilute gas containing most of the mass of the Universe. Observations that might reveal the existence of an intergalactic medium have been made at radio, optical, far uv, and x-ray wavelengths. If the IGM has a density comparable with the critical density required to close the Universe, then 21cm. radio observations and optical observations of QSO spectra imply that the gas is highly ionized and $T \gtrsim 10^4$ K. On the other hand, observations of the diffuse x-ray background indicate that the temperature of such a gas is probably $\lesssim 3 \times 10^8$ K. In the lower part of this range of temperatures the IGM would radiate mainly in the far uv. Alternatively the high degree of ionization of the gas may be maintained by a large uv flux from some as yet unidentified source. Thus it is considered that the far uv region of the spectrum is of considerable interest in connection with efforts to determine the density and temperature of the IGM. The expected intensities of various possible components of the far uv background are here discussed and the relevant observations are reviewed. Further observations are required to determine whether the IGM can be detected in the far uv or whether the extragalactic component of the background is masked by radiation of more local origin. There are several contributors to the far uv background radiation in addition to the possibility of emission from the IGM. The extragalactic background will include a contribution from galaxies and QSOs, and a galactic background will be present consisting of direct stellar radiation and a diffuse component resulting from starlight scattered by interstellar dust. Locally there will also be contributions from the Zodiacal light, as well as airglow emissions from the Earth's geocorona. A brief discussion is presented on what is known, theoretically or observationally, about each of these components. (UK)

4331 AIRBORNE MEASUREMENT OF THE TEMPERATURE OF THE COSMIC MICROWAVE BACKGROUND AT 3.3 mm. Boynton, P. E. (Univ. of Washington, Seattle); Stokes, R. A. Nature (London); 247: No. 5442, 528-530(22 Feb 1974).

It is stated that the "primaeval fireball" model of the Universe predicts a cosmic microwave background radiation field with the spectral character of a blackbody source. The radiation arises from an initially very dense and very hot Universe, followed by cooling to about 2.7K through cosmological expansion. Previous ground-based radiometric measurements at wavelengths as short as 3.3mm. are consistent with a 2.7K blackbody, but most of the observational points were in the Rayleigh-Jeans tail of such a blackbody spectrum. The short wavelength direct radiometric points are inconsistent with a grey body or power law spectrum but are consistent with a blackbody model. An attempt is described to obtain direct radiometric data, free from atmospheric effects, by using a 3.3mm. Dicke radiometer adapted for mounting in a jet aircraft, and carried above the tropopause. A thermodynamic temperature of 2.48 ± 0.54K was indicated. Details are given of the equipment and experimental technique adopted. A reference standard consisting of a microwave absorber immersed in liquid He was used. (UK)

4332 DYNAMO THEORY OF COSMIC MAGNETIC FIELDS. I. Equations for Spherical Dynamo Models. Raedler, K. H. (Zentral Institut fuer Astrophysik, Potsdam, Ger.). Astron. Nachr.; 294: No. 5, 213-223(1973). (In German).

A mathematical treatment is given of special models of magnetohydrodynamic dynamos. These models are characterized by the fact that the conducting medium occupies a spherical region, outside of which a vacuum prevails. In this study both laminar and turbulent dynamos are taken into account. The vector differential equations governing these models are transformed into an infinite system of differential equations for scalar functions by a method indicated by Bullard and Gellman (1954) which involves the representation of vector fields as the sum of a poloidal and a toroidal component. These scalar functions depend only on a radial coordinate and, possibly, on time. Under steady or periodically varying conditions an infinite system of ordinary differential equations can be obtained, which can be treated numerically. A series of relations for calculating various types of dynamo models is prepared. (IAA)

4333 PERIHELION MOTION AND COSMOLOGICAL SINGULARITY IN TREDER'S GRAVITATION THEORY. Kasper, U. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Astron. Nachr.; 294: No. 5, 201-206(1973). (In German).

Investigation of the consequences of a class of field equations is considered within the framework of Treder's gravitation theory insofar as the values of the redshift, the light deflection, and the perihelion motion are concerned. It is shown that if the integration constants of the spherically symmetric vacuum metric are chosen in such a way that the redshift and light deflection for a mass point assume the Einsteinian values, then a formula for the peri-

helion rotation can be obtained which involves the Einsteinian value of this rotation and a parameter which characterizes the investigated class of field equations. For large absolute values of this parameter the value of the perihelion rotation approaches the Einsteinian value. Only for values of this parameter greater than 2/5 do cosmological models without a cosmological singularity exist. (IAA)

4334 GAMMA-RAY BACKGROUND: A CONSEQUENCE OF METAGALACTIC COSMIC RAY ORIGIN. Strong, A. W.; Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 1, 129-134(1 Jan 1974).

An estimate is made of the γ-ray spectrum resulting from an extragalactic, evolving source model of cosmic-ray origin in the absence of intergalactic gas. The experimental situation does not at present appear to allow definite rejection of this theory, since the calculated spectrum lies between the extreme observational limits. It is possible that such a theory can explain the cosmic-ray spectrum, the isotropy of cosmic rays, and the diffuse γ-ray spectrum. (auth)

4335 SEARCH FOR SMALL-SCALE ANISOTROPY IN THE 2.7°K COSMIC BACKGROUND RADIATION AT A WAVELENGTH OF 3.56 CENTIMETERS. Carpenter, R. L. (California State Univ., Los Angeles); Gulkis, S.; Sato, T. Astrophys. J.; 182: No. 2, L61-L64(1 Jun 1973).

Drift scans were made of a selected track on the sky to search for small-scale anisotropy in the microwave background radiation. The observations were made with the 64-m antenna at Goldstone, California, operating at 3.56 cm. The half-power beam width was 2′.3′. The scans were approximately 1° in length. The upper bound on the small anisotropy along the track is $\Delta T/T < 7.15 \times 10^{-4}$ (90 percent confidence). Some implications of this result are discussed. (auth)

Planetary Phenomena

4336 (CONF-720724-P2, pp 407-414) CHARGED PARTICLE TRACKS IN LUNAR GLASSES. Durrani, S. A.; Kahn, H. A. (Univ. of Birmingham, Eng.). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Charged-particle track parameters were measured in lunar glasses and crystals, with special emphasis on light brown and light green glasses in Apollo 15 samples. (WDM)

4337 (CONF-720724-P2, pp 415-424) HISTORY OF THE SOLAR COSMIC RAY IRRADIATION OF OLIVINE AND FELDSPAR CRYSTALS, SEPARATED FROM THE 200-MESH FRACTION OF THE DIRT COLUMN SUPPLIED BY THE LUNA-16. Kashkarov, L. L. (Inst. of Geochemistry and Analytical Chemistry, Moscow); Morett, M.; Moris, P.; Vassan, B. 1972. (In Russian).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The results of the study of the tracks observed in feldspar and olivine crystals removed at different depths from the dust column supplied by Luna 16 are reported. Special attention was given to the tracks formed by comparatively low-energy solar cosmic radiation. The track density distribution was determined as a function of the depth of the sample. Analysis of the track densities obtained indicated that the crystals had been irradiated with low-energy nuclei of the Fe group of the solar cosmic radiation. The results were compared with those obtained from Apollo 15 samples. (JSR)

4338 MINOR AND TRACE ELEMENT DISTRIBUTION IN MELILITE AND PYROXENE FROM THE ALLENDE METEORITE. Mason, B. (Smithsonian Institution, Washington, DC); Martin, P. M. Earth Planet. Sci. Lett.; 22: No. 2, 141-144(May 1974).

Melilite and pyroxene were separated from a coarsely crystalline chondrule in the Allende meteorite and analyzed by microprobe and spark source mass spectrometer techniques. Elemental abundances in the bulk chondrule are consistent with a mixture of equal amounts of the two minerals, as observed microscopically. The lanthanide distributions are markedly different in the two minerals; relative to chondrite abundances, melilite shows progressive depletion of the lanthanides La–Sm, a positive Eu anomaly, and relatively constant abundances of the heavier lanthanides (Gd–Yb, and Y), whereas pyroxene shows progressive enrichment towards the heavier lanthanides, on which is superimposed a negative Eu anomaly. Both minerals, and the bulk chondrule, show unusual concentrations of the platinum metals, but the crystallographic site or sites of these metals remain to be determined. (auth)

4339 STUDIES ON THE THERMOLUMINESCENCE DEPTH PROFILE PRODUCED BY 600-MeV PROTONS IN ARTIFICIAL LUNAR SOIL. Baer, K.; Herr, W. (Univ., Cologne). Earth Planet. Sci. Lett.; 22: No. 2, 188-195(May 1974).

The thermoluminescence (TL) of various plagioclase feldspars embedded in a thick target of 150 kg of artificial lunar soil was measured after a 600-MeV proton irradiation. No correlation was observed between the parameters of the characteristic feldspar glow peak and the anorthite contents. The relative TL sensitivities of the individual plagioclase variants were measured and found to be practically the same for ^{60}Co-γ and 600-MeV proton-irradiated samples. The TL intensity distribution within the target arrangement, converted to a 2π isotropic p-influx, resulted in an approximate TL depth prof e of a thermally undisturbed lunar soil bombarded by galactic cosmic protons. The undisturbed TL intensity at a depth of 28 g/cm^2 (≙17 cm) decreased to 39% at a depth of 106 g/cm^2 (≙60 cm). For the evaluation of the temperature gradients by TL in lunar samples the experimental data at the sites of Taurus-Littrow and of Hadley-Rille yielded minimum depth intervals for sampling of ~20 cm and ~40 cm respectively, presuming an error of ±15% in the TL determination. Certain aspects are seen by using the relation TL intensity/^{22}Na-activity ratio versus depth (thus representing the total ionization profile) to establish ^{22}Na depth profiles. (auth)

4340 RADIOS OF RADIO BRIGHTNESS TEMPERATURES OF MARS AND JUPITER AT THE WAVELENGTHS OF 2.35 AND 8.15 mm. Efanov, V. A.; Kislyakov, A. G.; Moiseev, I. G.; Naumov, A. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 185-191 (1974). (In Russian).

The results are presented of observations of Mars by the method of comparison with Jupiter during great opposition of Mars in 1971. Observations were made using RT-22 KAO of the Academy of Sciences of the USSR. The ratios of the mean disc radio brightness temperatures of Mars and Jupiter appeared to be equal to 1.6 ± 0.3 and 1.4 ± 0.05 at the wavelengths of 2.35 and 8.15 mm, respectively. The results of measurements are compared with the data of other observations and with calculated spectra of Mars radiation. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 5789.

4341 (BUP-57) MORPHOLOGY AND FINE TIME STRUCTURE OF AN EARLY-MORNING ELECTRON PRECIPITATION EVENT. Trefall, H.; Ullaland, S.; Stadsnes, J.; Singstad, L.; Pytte, T.; Broenstad, K.; Bjordal, J.; Karas, R. H.; Brown, R. R.; Muench, J. (Bergen Univ. (Norway). Dept. of Physics). Oct 1973. 45p.

Simultaneous balloon recordings of auroral zone x rays from precipitating electrons, covering a range of L-values from ≈ 5 to ≈ 7.5, are presented. The precipitation event occurred from about 0200 to 0500 local magnetic time, and was associated with a negative magnetic bay. Before the bay, precipitation associated with the growth phase of the substorm was observed at high L-values. After bay onset, precipitation was observed over the whole range of L-values covered, but showing a delayed onset in the southern part of the precipitation region as compared with the onset of CNA-absorption in the local midnight sector. At high L-values the x-ray flux was completely unstructured and drizzle-like, both before and after bay onset. At low L-values, where precipitation occurred only after bay onset, the event was splash-like with x-ray bursts of typically 2 to 6 sec duration apparently arising from the cosmic-ray background. The precipitation bursts had spatial extensions of 300 to 400 km. They were accompanied by weak magnetic impulses, which were, both temporally and spatially, closely related to the x-ray bursts. The unstructured precipitation at high L-values was apparently associated with, and extending along, the auroral electrojet, presumably representing freshly accelerated particles. The highly structured and burst-like precipitation to the south seems to have come from a cloud of electrons drifting out from the acceleration region, from which wave-particle instabilities or some other mechanism caused electrons to be precipitated. (auth)

4342 (N-73-18367) ANALYSIS OF PHOTOMETRIC DATA OBTAINED ON THE 1969 NASA AIRBORNE AURORAL EXPEDITION. Final Report, 1 May 1971–31 December 1972. Romick, G. J. (Alaska Univ., College (USA). Geophysical Inst.). 31 Dec 1972. 11p. (NASA-CR-130916). NTIS $3.00.

The analysis of the 1969 airborne expedition data is centered around two main topics: dayside auroral characteristics and hydroxyl airglow variations. Some of the conclusions drawn from the analysis include the following: (1) The midday sector of the auroral oval is bound on the equatorward side by a region of ≥ 3 keV electrons. (2) The dayside oval is associated with the cusp region in the magnetosphere which has particle energies usually ≤ 1 keV and λ 6300 (01)/λ 4278 N_2^+ ratios > 10. (3) Discrete Earth–Sun aligned auroras appear in the polar cap just poleward of the oval superimposed on a < 1 keV particle energy background. (4) The discrete Earth–Sun aligned auroras seen in the open field line region on the dayside have a similar appearance to some rayed auroras seen on the nightside both in terms of characteristic particle energy spectra as well as visual appearance. (5) Airglow OH measurements show no appreciable change with latitude or longitude but do show diurnal changes. Two types of enhancements are observed: one associated with visible aurora, and the other uncorrelated with visible aurora. (auth)

4343 A PROPOSED EXPERIMENT TO DETERMINE IF FIELD-ALIGNED CURRENTS CLOSE BY POLARIZATION CURRENTS. Atkinson, G. (Department of Communications, Communications Research Centre, Ottawa, Ontario, Canada). J. Geophys. Res. 78: No. 31. 7549-7551 (1 Nov 1973)

The proposed experiment consists of launching a rocket above the E region ionosphere completely through a quiet auroral arc that is either stationary or moving slowly with a known velocity and measuring the electric and magnetic moving slowly with a known velocity and measuring the electric and magnetic fields during the traverse. (AIP)

4344 ROCKET MEASUREMENT OF THE DIFFERENTIAL ENERGY SPECTRUM OF THE PHOTOELECTRONS. Mukai, T.; Hirao, K. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro-ku, Tokyo 153, Japan). J. Geophys. Res. 78: No. 34, 8395-8398 (1 Dec 1973).

The preliminary result of the spectral observation by means of a low-energy electron spectrometer aboard the sounding rocket K-9M-40, launched from Uchinoura, Japan, on September 20, 1972, at 1400 hours JST is reported. During the flight the solar zenith angle was about 43°, and the intensity of the solar 10.7-cm flux was 113×10^{-22} w/m^2 Hz. The experiment was successful in the altitude range 160–315 km during the ascent of the rocket. The principal result to be reported here is the detection of fine structures in the photoelectron energy spectra at low altitudes (—240 km). (AIP)

4345 HEATING OF THE LOWER IONOSPHERE BY POWERFUL RADIO WAVES. Holway, L.H. Jr. (Raytheon Research Division, Waltham, Massachusetts 02154); Meltz, G. J. Geophys. Res. 78: No. 34, 8402-8408 (1 Dec 1973).

It is shown that calculations based upon generally accepted formulas for electron energy loss to rotational states of N_2 and to fine-structure transitions in O predict unexpectedly large increases in the electron temperature when the D and E regions are irradiated by radio waves having frequencies and power densities comparable to those attainable with the Platteville Ionospheric Modification Facility. (AIP)

4346 PARTICLE ACCELERATION BY AN ELECTROSTATIC WAVE WITH SPATIALLY INCREASING PHASE VELOCITY. Bloomberg, H.W.; Gary, S.P. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). J. Geophys. Res. 78: No. 31, 7531-7535 (1 Nov 1973).

The motion of charged particles initially trapped within the potential troughs of electrostatic waves with fixed frequency and spatially decreasing wave number is considered. It is shown that these particles can gain velocities substantially greater than those that occur at the time when the oscillatory motion ceases. (auth)

4347 SUBSTORM EFFECTS IN AURORAL SPECTRA. Eather, R.H. (Boston College, Chestnut Hill, Massachusetts 02167); Mende, S.B. J. Geophys. Res. 78: No. 31, 7515-7520 (1 Nov 1973).

A substorm time parameter is defined and used to order a large body of photometric data obtained on aircraft expeditions at high latitudes. The statistical analysis demonstrates hardening of the electron spectrum at the time of substorm, and it is consistent with the accepted picture of poleward expansion of aurora at the time of substorm and curvature drift of substorm-injected electrons. These features are not evident from a similar analysis in terms of magnetic time. We conclude that the substorm time concept is a useful ordering parameter for auroral data. (auth)

4348 FINITE β DRIFT ALFVEN INSTABILITY. Chance, M.S. (Department of Physics, University of California, Los Angeles, California 90024); Coroniti, F.V.; Kennel, C.F. J. Geophys. Res. 78: No. 31, 7521-7530 (1 Nov 1973).

We propose a means by which the theory of drift instabilities can be extended to plasmas of arbitrary β. We then concentrate on the drift Alfvén instability driven by an electron temperature gradient, proposed by Coroniti and Kennel (1970) to be a source of Pi 1 micropulsations on auroral lines of force. Even at relatively low β the full finite β theory differs considerably from previous low β theories and produces better agreement with observation. (auth)

4349 DETERMINATION OF THE ELECTRON LOSS COEFFICIENT IN THE IONOSPHERIC F REGION. Khocholava, G. M.; Mebagishvili, N. N. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: 601-604 (Sep 1973). (In Russian).

The effective electron loss coefficient in the F region was determined from nighttime N(h) profiles obtained at Washington during the period from 1957 to 1958 and at Moscow in 1964. The coefficient was determined with the aid of the ionization balance equation with allowance for all terms except the electromagnetic drift term, which is unimportant for midlatitudes. It was found that the value of this coefficient amounts to about 0.0001 per sec under quiet conditions and to 0.0002 per sec under perturbed conditions. A tendency for the coefficient to increase approximately threefold when the temperature of the neutral atmosphere increases by 100 to 150 K was noted, as well as a tendency for the coefficient to increase with an increase in the level of geomagnetic activity. (IAA)

4350 AURORAL SUBSTORMS AND THE INTERPLANETARY MAGNETIC FIELD. Akasofu, S.; Perreault, P.D.; Yasuhara, F. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701); Meng, C. J. Geophys. Res. 78: No. 31, 7490-7508 (1 Nov 1973).

The Alaska meridian all-sky photographs from 1966 and 1970 are compared with the corresponding interplanetary magnetic field data. More than 50 auroral substorms are identified, and their onset times (T=O) determined. Some of the important findings in this correlative study are as follows: (1) During quiet periods, auroral substorms are quite common along the contracted oval even when the north-south component B_z is positive; such substorms occur beyond the field of

view (both photographically and magnetically) of an AE station. (2) During moderately disturbed periods, even when allowance is made for the IMF signal transition time, it is difficult to find any consistent IMF signature that can be readily identified as that which can be related to the onset of auroral substorms; specifically, we examined $B_z > 0$, $B_z < 0$, $\partial B_z/\partial t$, and so forth. From (1) and (2) we conclude that $B_z < 0$ is not always a necessary condition for triggering mechanisms and that $B_z < 0$ is primarily responsible for shifting the oval equatorward to the latitude of AE stations. (auth)

4351 LABORATORY SIMULATION OF ARTIFICAL PLASMA CLOUDS IN THE IONOSPHERE. Morse, D.L.; Destler, W.W. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). J. Geophys. Res. 78: No. 31, 7417-7430 (1 Nov 1973).

The results of an experiment to model the behavior of artifical plasma clouds in the ionosphere are presented. The formation of field-aligned structure of 'striations' is frequently observed. The appearance of this structure and its subsequent motion are found to be in qualitative agreement with theory. In particular, the ratio of the integrated Pedersen conductivity of the cloud to that of the background through which it moves is found to be an important factor determining the growth rate of the striations. (auth)

4352 A CATALOG OF IONOSPHERIC F REGION IRREGULARITY BEHAVIOR BASED ON OGO 6 RETARDING POTENTIAL ANALYZER DATA. McClure, J.P.; Hanson, W.B. (The University of Texas at Dallas, Dallas, Texas 75230). J. Geophys. Res. 78: No. 31, 7431-7440 (1 Nov 1973).

The Ogo 6 retarding potential analyzer was used ~50% of the time to measure the total ion concentration N_i along the satellite path. In this paper we catalog the wave forms of the ionospheric F region irregularities observed and discuss their morphological behavior. The middle- and low-latitude ionosphere is usually remarkably smooth, to within at least 0.1% in $\Delta N/N$, even at night, if we ignore wavelengths greater than 100 km. Transitions from a smooth to an irregular ionosphere in several different latitude regions are presented and discussed. Transitions may be either abrupt or gradual. The poleward edge of the nighttime mid-latitude trough is almost always associated with the onset of soft auroral electron fluxes and large amplitude auroral irregularities in N_i. If mid-latitude irregularities are also present on a given pass, there is often a minimum in $\Delta N/N$ in the trough region. Examples of low-latitude irregularities are presented. These irregularities can have very large amplitudes, comparable to the largest auroral $\Delta N/N$ values. Since ionospheric scintillation depends on ΔN and not on $\Delta N/N$, one would therefore expect stronger scintillation at low latitudes than at high latitudes, as is observed, since equatorial N_i values are generally larger than those at high latitudes. The above morphological characteristics apply to the typical noiselike irregularity wave forms, whose spectral properties appear to be relatively constant, independent of latitude, local time, or the rms amplitude of $\Delta N/N$, for example. In addition to the noiselike irregularities, we catalog examples of other irregularity categories, such as sinusoidal wave forms, an equatorial phenomenon; ground glass irregularities, mainly observed at mid-latitudes; and breaking waves, seen at all latitudes. (auth)

4353 A DESCRIPTIVE MODEL OF F LAYER HIGH-LATITUDE IRREGULARITIES AS SHOWN BY SCINTILLATION OBSERVATIONS. Aarons, J. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730). J. Geophys. Res. 78: No. 31, 7441-7450 (1 Nov 1973).

Observations in the northern hemisphere of the amplitude fluctuations of radio signals from satellites and radio stars being used as a data base, a model is sketched of the high-latitude F layer irregularity region. On the nightside, irregularity intensity increases from a low level at its equatorward boundary position of ~57° at 2200 hours LT to a higher level within the auroral oval. A high level of irregularity intensity exists over the corrected geomagnetic pole. However, the data base for quantitative measurements at latitudes poleward of the auroral oval is small. On the dayside the scintillation boundary is in the region of 70° for quiet to moderate magnetic conditions. During all hours an increase in magnetic activity brings on deeper fading across the entire high-latitude region, from the equatorward scintillation boundary to the geomagnetic pole. Precipitation of electron with energies of the order of a few hundred electron volts is not thought to be the mechanism for the production of small-scale irregularities. In this energy range, electron precipitation shows a low occurrence in the polar cavity, whereas scintillations remain high in this region. Measurements of suprathermal electrons show polar patterns closer to the scintillation observations than measurements of high-energy electrons. Irregularities observed in satellite observations of the high-energy electrons. Irregularities observed in satellite observations of the thermal electrons (R. Sagalyn, private communication, 1973) at high latitudes including polar areas show geomagnetic occurrence patterns similar to those shown in this paper. In their measurements of turbulent isotropic electric field at 400 km Kelley and Mozer (1972) have found variations with latitude in the boundary region, the auroral oval, and over the pole that resemble the scintillation variations of this model. (auth)

4354 INCOHERENT SCATTER RADAR OBSERVATIONS OF THE AURORAL ZONE IONOSPHERE DURING THE TOTAL SOLAR ECLIPSE OF JULY 10, 1972. Baron, M.J. (Stanford Research Institute, Menlo Park, California 94025); Hunsucker, R.D. J. Geophys. Res. 78: No. 31, 7451-7460 (1 Nov 1973).

Observations of the behavior of the auroral zone ionosphere were made with the incoherent scatter radar at Chatanika, Alaskaa, during the total solar eclipse of July 10, 1972. The radar beam intersected the approximate center of the eclipse shadow at a height of 400 km. The electron temperature decreased by more than 1200°K, and the ion temperature decreased by approximately 100°K near eclipse totality. Electron concentrations in the E and lower F regions decreased by 50%. Concentrations above the F layer peak decreased slightly, but there was no net change in ionization at the F layer maximum. Apparently, downward diffusion of upper F region ionization was just adequate to balance the loss processes at the layer maximum. An estimate of the heat input to the electron gas at 340 km showed that this quantity fell to about 25% of its background value during totality. Control radar data for the eclipse observations were obtained on July 9, 11, and 12, 1972, along with supporting vertical incidence ionosonde and magnetometer data acquired near College, Alaska. (auth)

4355 LOW-LATITUDE NIGHTTIME E REGION CONDUCTIVITIES. Rowe, J.F. Jr.; Mathews, J.D. (Arecibo Observatory, Arecibo, Puerto Rico 00612). J. Geophys. Res. 78: No. 31, 7461-7470 (1 Nov 1973).

Recent incoherent scatter electron density measurements made with 0.9-km-altitude resolution Barker-coded pulses are combined with the Jacchia neutral atmosphere model to generate nighttime electrical conductivities for the lower ionosphere at Arecibo. Electron density profiles and derived conductivities are presented for nights characterized by low and high magnetic activity. A model for nighttime electron densities incorporating 17 nights of data is presented along with the computed electrical conductivites. The features of the model include :(1) a sharply defined lower boundary at 85 km, (2) a layer between 85 and 120 km having an average density of 2×10^3 cm^{-3} and showing a weak symmetry about solar midnight due to the ionizing effect of scattered solar ultraviolet radiation, (3) a valley of low electron density above 120 km that is progressively filled in with ionization as magnetic activity increases, and (4) electron density enhancements in the upper E region occurring 4 hours after local midnight as a result of downward transport of plasma from the F region. Height-integrated conductivities calculated from the model and the two nights of observations are also given. (auth)

4356 POSSIBLE DETECTION OF A GRAVITY WAVE IN THE PHASE HEIGHT OF THE F REGION DUE TO THE ECLIPSE OF MARCH 7,1970. Butcher , E.C. (Aero-Astrodynamics Laboratory, NASA Marshall Space Flight Center, Marshall Space Flight Center, Alabama 35812). J. Geophys. Res. 78: No. 31, 7563-7566 (1 Nov 1973).

The generation of gravity waves due to the supersonic motion of the moon's shadow through the lower atmosphere has been observed for the eclipse of March 7, 1970. (AIP)

4357 FIRST MEASUREMENTS OF ELECTRON TEMPERATURE IN THE D REGION WITH A SYMMETRIC DOUBLE PROBE. Szuszczewicz , E.P. (Laboratory for Planetary Atmospheres, NASA-Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 78: No. 31, 7567-7568 (1 Nov 1973).

The first altitude profile of electron temperature in the ionospheric D region, as measured by the technique of the symmetric double probe flown on a Nike-Cajun (NASA 10.378) payload to an apogee of 78.5 km (MSL) is reported. The launch was from White Sands, New Mexico, on October 13, 1971, at 1210 LMT. (AIP)

4358 OCCASIONS OF SAR ARC OBSERVATIONS AT THE BATTELLE OBSERVATORY NEAR RICHLAND, WASHINGTON. Hoch, R.J.; Smith, L.L.; Owen, R.W. (Battelle-Northwest Laboratories, Richland, Washington 99352). J. Geophys. Res. 78: No. 31, 7558-7559 (1 Nov 1973).

Occasions on which stable auroral red (SAR) arcs brighter than 50 rayleighs were detected from the Battelle Observatory near Richland, Washington are presented. (AIP)

4359 OBSERVATION AND INTERPRETATION OF O_2 1.27-μ EMISSION ENHANCEMENTS IN AURORA. Gattinger, R.L.; Jones, A.V. (Astrophysics Branch, National Research Council of Canada, Ottawa, Ontario, Canada). J. Geophys. Res. 78: No. 34, 8305-8313 (1 Dec 1973).

Enhancements of the O_2 1.27-μ night airglow emission in bright auroral displays have been observed in the zenith at Fort Churchill with a ground-based multichannel photometer. For the three events discussed, the enhancements, referred to the emitting region, were between 100 and 200 kR. The level of enhancement was related to the integrated brightness of the λ5577 [O I] emission, also monitored in the zenith, and the decay time was about 1 hour. With the aid of an auroral excitation model the O_2 1.27-μ emission enhancements have been

ascribed at least in part to secondary electron excitation of molecular oxygen. The calculated excitation efficiency depends strongly upon the primary electron spectrum. (auth)

4360 LOWER-ATMOSPHERIC GRAVITY MODES AND THEIR RELATION TO MEDIUM-SCALE TRAVELING IONOSPHERIC DISTURBANCES. Francis, S.H. (Bell Laboratories, Whippany, New Jersey 07981). J. Geophys. Res. 78: No. 34, 8289-8295 (1 Dec 1973).

Calculations reveal that the earth's atmosphere can support only two strongly ducted lower-atmospheric gravity modes, the S_1 and S_2 modes previously found by Friedman, with speeds of 312 m/sec and 253 m/sec at long periods. The principal finding of the present work is that Friedman's higher-order modes $S_i (i > 2)$, with speeds less than 250 m/sec, are weakly ducted and do not propagate for long distances. Since the bulk of observed medium-scale TID travel at speeds between 100 and 250 m/sec, below the speeds of the S_1 and S_2 modes, it is concluded that the hypothesis relating medium-scale TID to ducted modes is untenable. Instead, it is suggested that medium-scale TID are manifestations of freely propagating gravity waves. (auth)

4361 DENSITY GRADIENTS AND THE FARLEY-BUNEMAN INSTABILITY. Schmidt, M.J.; Gary, S.P. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). J. Geophys. Res. 78: No. 34, 8261-8265 (1 Dec 1973).

The linear kinetic theory of the Farley-Buneman instability is generalized to include the effect of density gradients on the electrons. Near threshold the growth rates are substantially enhanced. (auth)

4362 THE GENERATION OF INFRASONIC WAVES BY AURORAL ELECTROJETS. Swift, D.W. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). J. Geophys. Res. 78: No. 34, 8205-8221 (1 Dec 1973).

A nondispersive theory is developed for the generation of infrasonic waves by an auroral electrojet current of finite length. The electrojet is coupled to the neutral atmosphere by the Lorentz force and Joule heating. It is shown that when the motion of the electrojet is parallel to the electric field, the Lorentz force and the Joule dissipation terms, which are both significant, add, and when the motion and the electric field are opposite, the two terms substract. Solutions to the acoustic wave equation are obtained for both subsonic and supersonic motion of the electrojet. It is shown that unless the subsonic electrojet is moving at speeds very close to the speed of sound, the frequency components generated would be so low that the wave would be unobservable. Supersonic electrojets will generate enough high-frequency components to be observable over a wide range of speeds, but with diminishing amplitude as the speed increases above the sonic speed. The finite length of the electrojet is shown to have a significant effect on the observed wave form. The effect of the band-pass characteristics of the observing instruments is calculated to enable comparison between theory and experiment. It is shown that a wide variety of observed wave forms, including long wave trains, can be accounted for with very simple electrojet models. Finally, the effects of dispersion are estimated. (auth)

4363 VECTOR MEASUREMENTS OF F REGION ION TRANSPORT AT ARECIBO. Behnke, R.A. (Case Western Reserve University, Cleveland, Ohio 44106); Harper, R.M. J. Geophys. Res. 78: No. 34, 8222-8234 (1 Dec 1973).

Vector measurements of the ion transport velocity in the F region above Arecibo (18°N, 50° dip angle) are reported for two daytime and five nighttime periods. From these vector measurements both the electric fields and neutral winds in the F region can be found. Daytime results indicate eastward electric fields during the morning, changing to westward near 1400. The most outstanding feature of the nighttime results is a large (~3 mv/m) westward electric field at 0400. The overall diurnal electric field pattern suggests that an 8-hour tidal mode dominates the wind fields in the dynamo region. Daytime neutral wind measurements indicate the importance of ion drag in determining the neutral winds; the poleward winds are observed to be strongest at ~1000, though, according to satellite drag data and evidence presented here, the N-S neutral pressure gradient maximizes in the afternoon. At night the neutral winds are first seen to blow strongly equatorward but then abate and often blow poleward by 0200. Application of the neutral wind and electric field measurements to F region morphology indicates that (1) during sunset strong downward ion transport is the result of poleward neutral winds; (2) the generally occurring (at Arecibo) sudden drop in the height of the F layer near midnight is the result of a reversing wind from equatorward to poleward; and (3) the rise of the F layer often seen at ~0400 at Arecibo is the result of $E \times B$ drifts. Finally, there is a strong tendency for the ion motion to be horizontal. Possible reasons for this behavior are discussed. (auth)

4364 A PRELIMINARY STUDY OF THE NEUTRAL WIND IN THE AURORAL E REGION. Brekke, A.; Doupnik, J.R. (Department of Applied Physics and Information Science, University of California, San Diego, La Jolla, California 92037); Banks, P.M. J. Geophys. Res. 78: No. 34, 8235-8250 (1 Dec 1973).

Auroral zone E region neutral winds have been derived from simultaneous measurements of ion drift velocities at different altitudes by the incoherent scatter radar facility at Chatanika, Alaska (L=5.6, Λ=65°). The wind derived for quiet and moderately disturbed days shows a consistent pattern during the daytime and appears to be that expected from a day-night pressure asymmetry. In the nighttime, however, the winds are much more variable, apparently responding to the momentum transfer and heating effects of ion drag when sizable electric fields and electron densities are present. (auth)

4365 AURORAL CURRENTS, IRREGULARITIES, AND LUMINOSITY. Greenwald, R.A. (Aeronomy Laboratory, NOAA Environmental Research Laboratories, Boulder, Colorado 80302); Ecklund, W.L.; Balsley, B.B. J. Geophys. Res. 78: No. 34, 8193-8203 (1 Dec 1973).

On March 16, 1972, high spatial resolution VHF backscatter measurements of evening diffuse radar aurora were obtained at NOAA radar site near Anchorage, Alaska. These measurements indicate that the region of radar aurora has considerable time-varying and latitudinal structure. Comparison of the dynamics of this region with concurrent magnetograms indicates that the irregularities are spatially coincident with the evening eastward auroral electrojet and indeed appear to be generated by the electrojet current flow. Additional comparison of the radar data with all-sky camera photographs indicates that the diffuse radar auroral irregularities and hence the eastward auroral electrojet occur in a latitudinal zone that is equatorward and adjacent to the region of visual auroral activity. Finally, discrete radar auroral echoes, which were observed in the premidnight hours, were located on the poleward edge of the visible aurora and appeared after westward traveling spirals or surges passed through the radar beam. (auth)

4366 NUMERICAL MODELING OF THE DRIFT AND DEFORMATION OF IONOSPHERIC PLASMA CLOUDS AND OF THEIR INTERACTION WITH OTHER LAYERS OF THE IONOSPHERE. Lloyd , K.H.; Haerendel, G. (Max-Planck-Institute for Extraterrestrial Physics, Garching b. Munich, West Germany). J. Geophys. Res. 78: No. 31, 7389-7415 (1 Nov 1973).

The equations of ion motion and of the electric potential, which describe the behavior of a plasma cloud in the ionosphere, are solved by numerical methods, the real ionosphere being approximated by a layered model. It is found that the dominant physical processes depend in the ionospheric region into which the cloud is released. In the E layer the main process is a continuous exchange of the ions constituting the perturbation, which results in the original cloud ions becoming imbedded in the ionosphere and drifting with it. The perturbation thereby moves like a wave through the ionosphere. In the F region the exchange process is very slow, and distortion of the cloud by self-generated electric polarization fields becomes the dominant effect. A comparison of the computed distortion with observations on barium plasma clouds suggests that electrostatic coupling between the E and F layers, over the clouds suggest that electrostatic coupling between the E and F layers, over the scale size of the ion clouds, is usually not very efficient. The effects of an altitude dependent neutral gas wind and of ionospheric recombination processes have been examined. The altitude dependent neutral gas wind produces profound distortion in the cloud, but the ionospheric recombination processes appear to have no important quantitative effect. If small perturbations are introduced into the initial cloud distribution, they develop into fingers that closely resemble the observed striations in barium ion clouds. In the E region the perturbations are shed from the ion cloud into the ionospheric positive image cloud. (auth)

4367 DIRECT COMPARISON BETWEEN SATELLITE ELECTRIC FIELD MEASUREMENTS AND THE VISUAL AURORA. Swift, D.W. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701); Gurnett, D.A. J. Geophys. Res. 78: No. 31, 7306-7313 (1 Nov 1973).

Electric field data from two passes of the Injun 5 satellite, one corresponding to magnetically quiet conditions and one corresponding to substorm conditions, are compared with simultaneous all-sky camera data from College, Alaska. In each case, a significant deviation of the electric field from the expected $V \times B$ field (where V is the satellite velocity) was evident, and a distinct electric field reversal could be identified. In the region of substantial electric field equatorward of the electric field reversal a diffuse auroral arc was observed during the magnetically quiet pass, and auroral patches were observed during the substorm pass. In the substorm case the electric field reversal occurred very near a discrete auroral arc at the poleward side of the diffuse arcs and patches. Comparison of the quiet time and substorm cases suggests that the convection electric field penetrates deeper into the magnetosphere during a substorm. (auth)

4368 QUIET AURORAL ARCS AND ELECTRODYNAMIC COUPLING BETWEEN THE IONOSPHERE AND THE MAGNETOSPHERE, 1. Sato[1], T.; Holzer, T.E. (Aeronomy Laboratory, NOAA Environmental Research Laboratories, Boulder, Colorado 80302). J. Geophys. Res. 78: No. 31, 7314-7329 (1 Nov 1973).

The magnetosphere–ionosphere system associated with the nighttime auroral region is considered for quiet conditions, and it is shown that in the presence of an electric field an ionospheric electron density perturbation that is narrow in latitude and broad in local time will grow exponentially in time, driving an ac current through the magnetosphere–ionosphere system. Under favorable conditions a field-aligned current-driven instability is excited in the lower magnetosphere, and associated wave-particle interactions give rise to pitch angle scattering of energetic magnetospheric particles and an anomalous resistivity along field lines. In a region of upward field-aligned current the pitch angle scattering and the field-aligned electric field (arising from anomalous resistivity) lead to an enhanced flux of precipitating magnetospheric electrons and an energization of these electrons that in turn give rise to an enhanced auroral electrojet current and a nearly coincident visible auroral arc. (auth)

4369 QUIET AURORAL ARCS AND ELECTRODYNAMIC COUPLING BETWEEN THE IONOSPHERE AND THE MAGNETOSPHERE, 2. Holzer, T.E.; Sato, T. (Aeronomy Laboratory, NOAA Environmental Research Laboratories, Boulder, Colorado 80302) J. Geophys. Res. 78: No. 31, 7330-7339 (1 Nov 1973).

The auroral arc model of Sato and Holzer (1973) (this issue) is extended and applied to the real auroral ionosphere–magnetosphere system. A discussion is presented of the model's predictions regarding electric fields in and near quiet arcs, the spacing of multiple arcs, the latitudinal conjugacy of quiet arcs, the location of quiet arcs, and the current system (field aligned and cross field) associated with quiet arcs. These predictions are then compared with relevant observations, and it is found that the model is reasonably consistent with existing observational data. (auth)

4370 SPACE SHUTTLE PAYLOADS. Proceedings of Symposium Held at the Annual Meeting of the American Association for Advancement of Science, Washington, DC, December 27–28, 1972. Morgenthaler, G. W.; Bursnall, W. J. (eds.). Science and Technology Series, Volume 30. Tarzana, CA; American Astronautical Society (1973). 529p. (CONF-721236-). Univelt, Inc., Tarzana, CA.

Twenty-two papers and a panel discussion were presented concerning the various characteristics of the Space Shuttle System and its contemplated payloads. (WDM)

4371 ELECTRON LOSS PROCESSES IN THE LOWER D-REGION DURING THE DECAY OF SOLAR X-RAY FLARE EVENTS. Perona, G. E. (Politecnico di Turin). J. Atmos. Terrest. Phys.; 36: No. 5, 897-902(May 1974).

Data concerning the recovery of the lower D region during the decay of solar x-ray events, are examined. A simple discussion of such results in terms of a two positive-ion model, has shown possible ranges for some significant parameters of the D region, in agreement with previous experimental determinations. (auth)

4372 RELATIVE CONTRIBUTION FROM DISSOCIATIVE RECOMBINATION OF O_2^+ TO THE EXCITATION OF $O(^1S)$ IN PULSATING AURORA. Brekke, A. (Auroral Observatory, Tromsoe, Norway). Phys. Norv.; 7: No. 1, 9-12(1973).

A large amount of photometrical data of pulsating aurora were utilized to investigate the contribution of dissociative recombination of O_2^+ relative to direct electron impact on $O(^3P)$ to the production of $O(^1S)$ in aurora. It is found that the importance of dissociative recombination decreases with altitude and is most important where the quenching of $O(^1S)$ is dominant. (auth)

4373 EXOSPHERIC MODELS OF THE TOPSIDE IONOSPHERE. Lemaire, J.; Scherer, M. S. (Belgian Inst. for Space Aeronomy, Brussels). Space Sci. Rev.; 15: No. 5, 591-640(Mar 1974).

The historical evolution of the study of escape of light gases from planetary atmospheres is delineated, and the application of kinetic theory to the ionosphere is discussed. Ionospheric plasma becomes collisionless above the ion-exobase which is located near 1000 km altitude in the trough and polar regions, and which coincides with the plasmapause at lower latitudes. When the boundary conditions at conjugate points of a closed magnetic field line are different, interhemispheric particle fluxes exist from the high-temperature point to the low-temperature point, and from the point of larger concentrations to the point of smaller concentrations; therefore the charge separation electric field in the exosphere is no longer given by the Pannekoek–Rosseland field. For nonuniform number densities and temperatures at the exobase, the observed r^{-4} variation of the equatorial density distribution is recovered in the calculated density distributions. Taking account of plasmasheet particle precipitation does not change very much the electric field and ionospheric ion distributions, at least for reasonable densities and temperatures of the plasmasheet electrons and protons. For field aligned current densities along auroral field lines smaller than 10^{-5} Am^{-2}, the potential difference between the ion-exobase and plasmasheet is about −3V. In the case of open magnetic field lines the flow speed of hydrogen and helium ions in the exosphere becomes rapidly supersonic as a consequence of the upward directed charge separation electric field, whereas the oxygen ions have a negligible small bulk velocity. Adding a photoelectron efflux decreases the thermal electron escape but does not change significantly the number density distributions. (auth)

4374 CORUSCATION OF AURORAL PARTICLE FLUX AT COLLEGE, ALASKA. Berkey, F. T. (Univ. of Alaska, College). J. Atmos. Terrest. Phys.; 36: No. 5, 881-887(May 1974).

Observations of pulsating aurora superimposed on a diffuse background of luminosity indicate that substorm precipitation is characterized by a much harder particle spectrum than that causing diffuse or mantle aurora. The temporal correlation of the pulsating aurora and increased radiowave absorption during the observations is the first direct evidence that the two phenomena are directly related. (auth)

4375 EXPERIMENTAL AND THEORETICAL STUDY OF THE D-REGION. I. Mid-Latitude D-Region Electron Density Profiles from the Radio Wave Interaction Experiment. Ferraro, A. J.; Lee, H. S.; Rowe, J. N.; Mitra, A. P. (Pennsylvania State Univ., University Park). J. Atmos. Terrest. Phys.; 36: No. 5, 741-754(May 1974).

In Part I a summary of quiet D-region electron density measurements made by the wave interaction technique at Pennsylvania State University for the period October 1969 through January 1971 is presented. The results include the mean features of noontime electron density profiles as well as the diurnal and seasonal variations. Detailed discussion on the methods of data analysis, including a critical evaluation of errors, is also presented. The results presented form a partial basis for developing the semi-empirical D-region model presented in Part II. (auth)

4376 EXPERIMENTAL AND THEORETICAL STUDY OF THE D-REGION. II. Semi-Empirical Model for Mid-Latitude D-Region. Rowe, J. N.; Mitra, A. P.; Ferraro, A. J.; Lee, H. S. (Pennsylvania State Univ., University Park). J. Atmos. Terrest. Phys.; 36: No. 5, 755-785(May 1974).

In this the second part of a series of papers on the experimental and theoretical studies of the D region, a semi-empirical effort is made to construct profiles of electron density, positive ion density, and positive and negative ion composition for mid-latitude summer daytime for moderate solar activity period. Several specific constraints are defined in terms of current experimental data which the models have to satisfy. The basis of the model building is the six-ion chemical scheme originally proposed by Mitra and Rowe (J. Atmos. Terr. Phys.; 34: 795 (1972)) to explain changes in mesospheric chemistry during solar flares; the key parameters of the six-ion scheme are adjusted against the observational constraints. The resulting distributions of electron density, of positive ions, of the negative to electron ratio λ and of positive-ion composition are given. It has been possible to achieve reasonable agreement with observational data excepting for the heights above 90 km. (auth)

4377 SECOND FIFTEEN YEARS IN SPACE. Proceedings of the Eleventh Goddard Memorial Symposium, Washington, DC, March 8–9, 1973. Ferdman, S. (ed.). Science and Technology Series, Volume 31. Tarzana, CA; American Astronautical Society (1973). 208p. (CONF-730356-). Univelt, Inc., Tarzana, CA.

Twelve papers were presented on the national and international aspects of the program, as well as the technology outlook and planetary missions to Mars. (WDM)

4378 NEW ROUTE FOR THE QUENCHING OF $N_2(A^3\Sigma_u^+)$ IN THE AURORA. Malcolme-Lawes, D. J. (Univ. of Kent, Canterbury, Eng.). Nature (London); 247: No. 5442, 540-541(22 Feb 1974).

It is stated that the volume production rate of $N_2(A^3\Sigma_u^+)$ in the aurora, as estimated from the observed emission rates in the N_2 first positive and second positive systems, is an order of magnitude greater than the observed emission rate. This implies a high rate of quenching by other species present in the auroral region, the most prominent of which are N_2, O_2, N, O, and NO. It has been predicted that collision with O-atoms makes a major contribution to the quenching process, but such quenching in the aurora would have to proceed with an efficiency much greater than observed in the laboratory in order to account for the observed intensities, and it is clear that present understanding of the quenching mechanism is incomplete. Some reactions of gas phase N-atoms have been studied, using the nuclear process $^{14}N(n,2n)^{13}N$. It was found that in mixtures of N_2 and O_2, ^{13}N forms only two products, N ^{13}N and N ^{13}NO, which were detected by radio gas chromatography, the latter product forming readily in the presence of minimal quantities of oxygen. It is suggested that

N_2O may be one of the species produced in the aurora as a result of the chemical reaction of N_2 ($A^3\Sigma_u^+$) with oxygen, and a number of chemical processes, as well as photodissociation, would be expected to result in the rapid destruction of N_2O formed. A measurement of N_2O density in the aurora is desirable. (UK)

4379 INVESTIGATION OF SOLAR ECLIPSE EFFECT ON THE SUBPOLAR STRATOSPHERE. Randhawa, J. S. (White Sands Missile Range, NM). J. Geophys. Res.; 78: No. 30, 7139-7144 (20 Oct 1973).

An experiment to study the effect of partial solar eclipse on the stratosphere was performed at Poker Flat, Alaska (65°07'N, 147°28'W), where a partial solar eclipse occurred on July 10, 1972. Chemiluminescent ozonesondes were deployed by Arcas meteorological rockets to an altitude of 50-55 km. After ejection the sensors descended via radar reflective parachutes and transmitted alternately ozone content and ambient temperature. Soundings were made during the week of the eclipse as well as during and immediately before and after it. Results obtained indicate that there was no significant effect due to the eclipse on ozone concentration, temperature, and winds in the upper stratosphere of the subpolar region. (auth)

4380 TURNOVER TIMES OF ^{137}Cs AND HTO IN THE TROPOSPHERE AND REMOVAL RATES OF NATURAL AEROSOL PARTICLES AND WATER VAPOR. Ehhalt, D. H. (National Center for Atmospheric Research, Boulder, CO). J. Geophys. Res.; 78: No. 30, 7076-7086 (20 Oct 1973).

The average vertical fluxes $\langle J \rangle$ of ^{137}Cs and HTO between 40° and 50°N are calculated from the mixing ratio profiles in the upper troposphere and from the surface deposition. During spring 1966, $\langle J_{Cs} \rangle = 0.67$ ^{137}Cs atoms/cm^2 sec and $\langle J_T \rangle = 51$ HTO molecules/cm^2 sec. From these fluxes and from the vertical profiles of the mixing ratio the turnover times are estimated as a function of altitude. These times increase from a few days in the surface layer to 20 days for HTO and 30 days for ^{137}Cs at the tropopause. It is shown that the turnover times and their altitude dependence should hold approximately for all seasons between 30° and 50°N. The tracer turnover times can be interpreted as removal times of natural aerosol particles and water vapor. In particular, they can be used to estimate the removal times of water vapor and aerosols injected by commercial aircraft in the upper troposphere. (auth)

Effects of Nuclear Detonations

4381 ENHANCEMENT OF ARTIFICAL ELECTRON BELTS THROUGH INTERACTIONS OF ELECTRONS WITH ION CYCLOTRON WAVES. Davidson, G.T. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 78: No. 31, 7569-7571 (1 Nov 1973).

A nuclear detonation at moderate or high altitudes in the atmosphere (above 50 km) releases an intense stream of beta decay electrons traveling upward along the geomagnetic field lines. It is generally assumed that most of the electrons will continue at relatively small pitch angles and be lost in the atmosphere in the opposite hemisphere. However, there is some evidence that significant numbers of electrons with small pitch angles can be turned toward larger pitch angles and trapped. Several moderately high altitude test detonations, particularly Teak and Orange on August 1, 1958, and August 12, 1958, respectively produced artifically trapped electrons. (AIP)

Magnetospheric Phenomena

Refer also to abstract 4266.

4382 (EGG-1183-1629) PAYLOAD PERFORMANCE OF SHAPED-CHARGE BARIUM RELEASES. Wright, D.; Broste, W.; Eastman, T.; Peek, H. M. (EG and G, Inc., Los Alamos, N. Mex. (USA)). 8 Apr 1974. 22p. (CONF-740435-1). Dep. NTIS $4.25.

From American Geophysical Union meeting; Washington, District of Columbia, USA (8 Apr 1974).

The utilization of a unidirectional barium jet generated by a shaped-charge explosive for visibly tracing out geomagnetic field lines is considered in terms of optical observations and analysis for events LORO, OOSIK, and CHACHALACA. (WDM)

4383 MAGNETOTAIL AND BOUNDARY LAYER PLASMAS AT A GEOCENTRIC DISTANCE OF ~18R_E: VELA 5 AND 6 OBSERVATIONS. Akasofu, S. (Geophysical Institute, University of Alaska, College, Alaska 99701); Hones, E.W. Jr.; Bame, S.J.; Asbridge, J.R.; Lui, A.T.Y. J. Geophys. Res. 78: No. 31, 7257-7274 (1 Nov 1973).

At the distance of the Vela satellite orbits ($r \simeq 18$ R_E) there are three distinct plasma environments associated with the earth's magnetotail: the plasma sheet, the high-latitude tail (or tail lobes), and the magnetotail boundary layer. This paper reports measurements of the plasma properties in these three regions made with electrostatic analyzers on Vela satellites 5A, 5B, 6A, and 6B. Evidence presented suggests that the plasma temperature profile across the thickness of the plasma sheet may be nearly uniform and very cool (proton average energy $\simeq$1 kev) after long geomagnetically quiet periods; the profile may be nearly uniform and very hot (proton average energy $\simeq$20-30 kev) immediately after a substorm. Except during these extreme cases the central part of the plasma sheet is hottest, and there is a gradual but substantial cooling toward the upper and lower edges. The magnetotail boundary layer, containing plasma less dense than that in the magnetosheath and flowing antisunward at less than magnetosheath flow speeds, is often very thin near the tail's magnetic midplane, but it is thousands of kilometers thick away from the midplane. We suggest that it may extend completely around the top and the bottom surfaces of the tail. The very low density plasma in the tail lobes is rather uniform over that portion of the height of the lobes explored with the Vela satellites. Comparisons of these observations with a magnetospheric model suggest that the boundary layer is the magnetic projection of the dayside cusps and may be a site of injection of magnetosheath plasma into the plasma sheet. (auth)

4384 MEASUREMENTS OF GEOMAGNETICALLY TRAPPED ALPHA PARTICLES, 1968-1970 1. QUIET TIME DISTRIBUTIONS. Krimigis, S.M.; Verzariu, P. (Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland 20910). J. Geophys. Res. 78: No. 31, 7275-7285 (1 Nov 1973).

Observations of geomagnetically trapped α particles over the energy range $1.18 \leq E_\alpha \lesssim 8$ Mev obtained with the Injun 5 polar-orbiting satellite during the period September 1968 to May 1970 are presented. The time history at $L \simeq 3$ and $B \simeq 0.19$ is dominated by the large intensity increase following the magnetic storm on October 31, 1968, during which the α particle intensity reached 2×10^3 (cm^2 sec ster)$^{-1}$ and the intensity ratio of α particles to protons (j_α/j_p) attained values of $\gtrsim 2 \times 10^{-3}$. The short-term decay of both α particles and protons in the same energy per nucleon range is similar, decay constants being ~40 days. The α particle fluxes and the j_α/j_p ratio attained minimum values in mid-1969 and in early 1970 of ~20(cm^2 sec ster)$^{-1}$ and ~2×10^{-4}, respectively, indicating that α particles are not replenished as readily as protons. The period February 11-28, 1970, was selected for detailed study, as representing the 'quiet time' trapped α particle population. During this period, it was found that (1) the α particle intensity versus L profile is most similar to the proton profile at the same energy per nucleon interval, (2) the j_α/j_p ratio is nearly constant as a function of L in the same energy per nucleon representation but rises sharply with L when it is computed in the same total energy interval, (3) the variation of α particle intensity with B suggests a steep ($j(\alpha) \propto \sin^n \alpha, n > 10$) angular distribution at small (~10° - 15°) equatorial pitch angles but the j_α/j_p ratio shows little dependence on B, and (4) the α particle spectral parameter E_0 shows a markedly different dependence on L from the equivalent one for protons. It is concluded on the basis of the observations that the source of the observed α particles during quiet times must be the solar wind or the upper ionosphere (via the polar wind) or some combination of the two but not directly captured solar particles. Further, the particle velocity appears to be the most physically plausible parameter in organizing the data for geomagnetically trapped nuclei. The data are compared with the theoretical model of Cornwall (1972), and it is found that reasonable agreement exists between the predictions and the observations. (auth)

4385 EQUATORWARD SHIFT OF THE CLEFT DURING MAGNETOSPHERIC SUBSTORMS AS OBSERVED BY ISIS 1. Yasuhara, F.; Akasofu, S. (Geophysical Institute, University of Alaska, College, Alaska 99701); Winningham, J.D.; Heikkila, W.J. J. Geophys. Res. 78: No. 31, 7286-7291 (1 Nov 1973).

Isis 1 satellite observations of the cleft position during magnetospheric substorms show that the cleft shifts equatorward as the interplanetary B_z component turns southward and substorm activity increases and that it shifts back toward higher latitudes as substorm activity subsides and B_z returns northward. Also, unusually low latitudes for the cleft (less than 70° invariant latitude) were found during geomagnetic storms with significant Dst values and large negative B_z values. Significant shifts occur in the cleft location with no accompanying effect seen in the AE index; however, B_z is observed to be southward during these periods. (auth)

4386 A STUDY OF THE ELECTRIC FIELD IN AN OPEN MAGNETOSPHERIC MODEL. Stern, D.P. (Laboratory for Space Physics, Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 78: No. 31, 7292-7305 (1 Nov 1973).

Recently, Svalgaard and Heppner reported two separate features of the polar electromagnetic field that correlate with the dawn-dusk component B_y of the interplanetary magnetic field. This work attempts to explain these findings in terms of properties of the open magnetosphere. The topology and qualitative properties of the open

magnetosphere are first studied by means of a simple model, consisting of a dipole in a constant field. Many such properties are found to depend on the separation line, a curve connecting neutral points and separating different field line regimes. In the simple model it turns out that the electric field in the central polar cap tends to point from dawn to dusk for a wide variety of external fields, but, near the boundary of the polar cap, electric equipotentials are deformed into crescents, which may explain the magnetic variation correlated with B_y and reported by Svalgaard. Modifications expected to occur in the actual magnetosphere are also investigated. The place of merging and convection in the model is outlined, and it is shown how the 'spilling out' of open polar field lines from a long narrow 'window' along the geomagnetic tail may explain the electric field asymmetries observed above the polar caps by Heppner. (auth)

4387 A FEEDBACK MODEL OF CYCLOTRON INTERACTION BETWEEN WHISTLER-MODE WAVES AND ENERGETIC ELECTRONS IN THE MAGNETOSPHERE. Helliwell, R.A.; Crystal, T.L. (Radioscience Laboratory, Stanford University, Stanford, California 94305). J. Geophys. Res. 78: No. 31, 7357-7371 (1 Nov 1973).

Cyclotron resonance is employed in a new model of the generation of narrow-band VLF emissions from the magnetosphere. Streaming energetic resonant electrons are temporarily phase-bunched by whistler-mode waves, causing transverse currents to be impressed on the medium. These currents act like circularly polarized antennas, producing stimulated Doppler-shifted radiation. The interaction takes place in an 'emission cell' located at or near the equatorial plane. Inclusion of feedback between the stimulated radiation and the incoming particles leads to a self-consistent description of fields and currents in time and space. Sample calculations are made for a wave frequency of 16.5 kHz and a homogeneous interaction region of 750-km length located on the equator at L=3. When there is a 1-my input wave and a stream density of 2.4 m^{-3}, regular pulsations with a period of 110 msec are produced. Above a threshold stream density of 1.5 m^{-3}, self-sustained oscillations grow exponentially when the system is triggered by a short pulse. Following saturation, a steady state is reached in which the frequency bandwidth is zero. Predictions of the model are in good agreement with experimental observations. (auth)

4388 EXPLORER 18 STUDY OF THE STABILITY OF THE MAGNETOPAUSE USING A KELVIN-HELMHOLTZ INSTABILITY CRITERION. Boller, B.R.; Stolov, H.L. (Department of Physics, The City College of the City University of New York, New York, New York 10031). J. Geophys. Res. 78: No. 34, 8078-8086 (1 Dec 1973).

Explorer 18 magnetometer and plasma probe data are used to calculate the magnitude of the Kelvin-Helmholtz instability criterion for 42 crossings of the magnetopause. The 30 crossings through the dipole field region show that for low levels of geomagnetic disturbance ($Kp \leq 2$) large regions of the magnetopause near the nose are stable, whereas for higher levels of geomagnetic disturbance ($Kp > 2$) only a small region near the nose is stable. The unstable regions are found further downstream. Similarly, the 12 crossings through the tail show that the unstable regions are downstream of the stable regions. The Kelvin-Helmholtz mechanism might be the 'viscous interaction' discussed by Axford and Hines and the relevant parameter for worldwide geomagnetic disturbance, just as the southward interplanetary field has been firmly established as the major relevant parameter in the case of substorm activity. (auth)

4389 SOLAR WIND AND SUBSTORM-RELATED CHANGES IN THE LOBES OF THE GEOMAGNETIC TAIL. Caan, M.N. (Department of Planetary and Space Science, University of California, Los Angeles, California 90024); McPherron, R.L.; Russell, C.T. J. Geophys. Res. 78: No. 34, 8087-8096 (1 Dec 1973).

Variations in the magnetic energy density in the lobes of the geomagnetic tail appear to be fundamentally associated with magnetospheric substorms. Thus in this paper the relationship of the tail lobe energy density to solar wind dynamic pressure, the north-south component of the interplanetary magnetic field, and substorm expansion onsets is investigated. Enhanced lobe energy densities are observed to follow both southward turnings of the interplanetary magnetic field and solar wind dynamic pressure increases. An empirical relationship is developed relating the tail lobe magnetic energy density to the solar wind dynamic pressure by using data obtained when the interplanetary field was northward. Localized, off-center, or multiple-onset substorm expansion phases are shown to have little effect on the lobe magnetic field. A positive correlation is found between magnetospherewide substorm expansions and decreases in the lobe energy density. The positive correlation of the energy density with both the solar wind dynamic pressure and a southward interplanetary magnetic field and the positive correlation between magnetospheric substorm activity and lobe energy density decreases are demonstrated to be consistent with our phenomenological model of substorm behavior. (auth)

4390 PLASMA SHEET AT LUNAR DISTANCE: CHARACTERISTICS AND INTERACTIONS WITH THE LUNAR SURFACE. Rich, F.J.; Reasoner, D.L.; Burke, W.J. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 78: No. 34, 8097-8112 (1 Dec 1973).

The plasma sheet at lunar distance is investigated with the use of data from the charged particle lunar environment experiment (CPLEE), complemented with data from the Explorer 35/ARC magnetometer. It is shown that the presence of the lunar surface does not appreciably affect measurements of the plasma sheet characteristics by the lunar-based CPLEE instrument. In particular, the lunar surface generally does not shadow plasma sheet particles. This may be due to rapid random passage (>40 km/sec) of magnetotail field lines with respect to the lunar surface or to diffusion of plasma sheet electrons into the flux tubes in contact with the lunar surface. The plasma sheet is generally observed as a rapid increase in observed particle fluxes and a simultaneous decrease in field strength. Analysis of the CPLEE data shows that, for the plasma sheet at lunar distance, typical quiet time parameters are $n = 0.10 \pm 0.05$ cm^{-3}, $kT_e = 200 \pm 50$ ev, and $kT_i = 2.5 \pm 0.75$ kev. The typical ranges for the parameters are 0.05-0.20 cm^{-3} for n, 175-325 ev for kT_e, and 1-5 kev for kT_i. The typical total (plasma plus magnetic) energy density is in the range 150-350 ev/cm^3. A statistical analysis of the CPLEE data shows that the plasma sheet in the midnight sector has a thickness of 5 $R_E \pm 2$ R_E. Geomagnetic activity reduces the probability of encounters between the moon and the plasma sheet. This finding is consistent with the concept that geomagnetic activity increases the variance of the plasma sheet from its average location and/or decreases its thickness. (auth)

4391 ATS-5 OBSERVATIONS OF ENERGETIC PROTON INJECTION. Bogott, F.H. (Space Sciences Laboratory, University of California, Berkeley, California 94720); Mozer, F.S. J. Geophys. Res. 78: No. 34, 8113-8118 (1 Dec 1973).

Energetic particle observations from ATS-5 are presented that directly show asymmetric injection of 30- to 300-kev proton fluxes into the nightside magnetosphere to form the asymmetric ring current. The temporal structure of these substorm-correlated proton bursts is consistent with a westward gradient drift from the nightside acceleration region. The drifting protons tend to be accompanied by nondiamagnetic decreases of the magnetic field at the satellite. Adiabatic decreases of the energetic electron fluxes often occur with these changes in the field strength. Nearly 200 proton-only events have been observed, occurring uniformly between 1500 and 2200 LT and not at all before 1200 LT or after 2300 LT. (auth)

4392 NIGHTSIDE ENERGETIC PARTICLE DECREASES AT THE SYNCHRONOUS ORBIT. Bogott, F.H. (Space Sciences Laboratory, University of California, Berkeley, California 94720); Mozer, F.S. J. Geophys. Res. 78: No. 34, 8119-8127 (1 Dec 1973).

More than 100 cases of major decreases of proton and electron fluxes at the synchronous orbit have been observed and interpreted as a movement of the energetic particle trapping boundary earthward of 6.6 R_E before the substorm expansion phase. These events are observed only between 1700 and 0800 LT and are consistent with the existence of a westward magnetospheric electric field of a few tenths of a millivolt per meter before substorm expansion. Most substorm particle events seen on the nightside do not exhibit this behavior, presumably because the trapping boundary moves inside 6.6 R_E only during major events. Such events show evidence of particle acceleration, which probably was concentrated at higher L values, near the instantaneous location of the trapping boundary. (auth)

4393 EFFECT OF MAGNETIC FIELD GRADIENT ON MOTION OF IONS RESONATING WITH ION CYCLOTRON WAVES. Cladis, J.B. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 78: No. 34, 8129-8135 (1 Dec 1973).

The gradient of the geomagnetic field may appreciably affect the energy that can be exchanged in resonant interactions between charged particles and circularly polarized waves. The equations of motion of a charged particle resonating with a circularly polarized wave in the presence of a field gradient are derived, and some numerical examples of the particle trajectories are given. It is shown that a charged particle moving upward along a magnetic field line may be accelerated to a very high energy while it is resonating with a wave propagating downward along the field line. Conversely, a charged particle moving downward may lose appreciable energy while it is resonating with a wave propagating upward. It is suggested that the energetic O^+ ions observed in the magnetosphere during a magnetic storm were principally accelerated by resonating with ion cyclotron turbulence generated by an unstable distribution of ring current protons. It is also suggested that resonant interactions occurring off the equator between ion cyclotron waves and the ring current protons may account for some of the unexplained features in the energy distribution of the protons. (auth)

4394 ELECTROMAGNETIC RADIATION TRAPPED IN THE MAGNETOSPHERE ABOVE THE PLASMA FREQUENCY. Gurnett, D.A.; Shaw, R.R. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). J. Geophys. Res. 78: No. 34, 8136-8149 (1 Dec 1973).

An electromagnetic noise band is frequently observed in the outer magnetosphere by the Imp 6 spacecraft at frequencies from about 5 to 20 kHz. This noise band generally extends throughout the region from near the plasmapause boundary to near the magnetopause boundary. The noise typically has a broadband field strength of about 5 μv m^{-1}. The noise band often has a sharp lower cutoff frequency at about 5 to 10 kHz, and this cutoff has been identified as the local electron plasma frequency. Since the plasma frequency in the plasmasphere and solar wind is usually above 20 kHz, it is concluded that this noise must be trapped in the low-density region between the plasmapause and magnetopause boundaries. The noise bands often contain a harmonic frequency structure which suggests that the radiation is associated with harmonics of the electron cyclotron frequency. The frequency spacing of these harmonics does not, however, appear to be related to the local electron cyclotron frequency. Possible mechanisms that could explain the generation of this noise are discussed. (auth)

4395 A SELF-CONSISTENT THEORY OF MAGNETOSPHERIC ELF HISS. Etcheto, J.; Gendrin, R.; Solomon, J.; Roux, A. (Groupe de Recherches Ionosphériques, Centre National d'Études des Télécommunications, Issy-les-Moulineaux, France). J. Geophys. Res. 78: No. 34, 8150-8166 (1 Dec 1973).

A self-consistent solution of the equation of wave generation and particle diffusion is obtained for gyroresonant interactions between ELF waves (a few hundred hertz) and medium-energy electrons (a few tens of kev). A dynamic equilibrium is considered in which new particles are continuously injected and ultimately lost in the atmosphere through diffusion inside the loss cone; meanwhile, waves are generated continuously, but only a fraction of them is reflected by the ionosphere. By an iterative process the wave spectrum can be computed in shape as well as in amplitude; the distribution function of the trapped particles is also obtained. Some of the concepts that were introduced by Kennel and Petschek (1966) are more precisely defined, and attention is drawn to possible misapplications of these concepts. In particular, it is established that the so-called limiting flux does not have a unique value and that it in fact depends upon the source strength: enhancements by factors of up to 20 can be achieved in very disturbed conditions ($Kp \geq 6$). It is also demonstrated that the particle distribution function, in an equilibrium configuration, does not depend on the cold plasma density, a conclusion that is of great geophysical importance. A comparison with experimental data shows a reasonable agreement with the theory and establishes its interest for interpreting ELF hiss and equilibrium particle distributions, at least inside the plasmasphere. (auth)

4396 THE TORQUE APPLIED BY THE SOLAR WIND ON THE TILTED MAGNETOSPHERE. Papagiannis, M.D. (Department of Astronomy, Boston University, Boston, Massachusetts 02215). J. Geophys. Res. 78: No. 34, 7968-7977 (1 Dec 1973).

The torque applied by the solar wind on the tilted magnetosphere was computed for a series of tilt angles between 0° and 35° by using the magnetopause models computed by Olson (1969) and taking advantage of the symmetry properties of the problem. The values obtained can be represented, with an error of less than 3%, by the semiempirical expression, $T = (M^2 \tan \chi)/(2r_s)^3$, where M is the dipole moment of the earth's magnetic field, χ is the tilt angle that the dipole axis forms with the normal to the solar wind, and r_s is the radial distance to the subsolar point of the magnetopause for the given tilt angle. The torque tries to restore the dipole axis to $\chi = 0°$, i.e., at right angles to the solar wind. A test using the magnetopause computations of Choe et al. (1973) confirmed that the rotation of the dipole axis is toward $\chi = 0°$, which is the position of stable equilibrium. The torque produced by the solar wind is of the order of 10^{21} g cm^2 sec^{-2} and hence is too small to have any effect on the 26,000-year precession of the rotational axis of the earth. It might be a factor, however, in the movements of the magnetic poles of the earth. (auth)

4397 MEASUREMENTS OF THE ATMOSPHERIC NEUTRON LEAKAGE RATE. Lockwood, J.A.; Ifedili, S.O.; Jenkins, R.W. (Physics Department, University of New Hampshire, Durham, New Hampshire 03824). J. Geophys. Res. 78: No. 34, 7978-7985 (1 Dec 1973).

The atmospheric neutron leakage rate in the energy range 10^{-2} to 10^7 ev has been measured as a function of latitude, altitude, and time with a neutron detector on board the Ogo 6 satellite. The latitude dependence of the neutron leakage is in reasonable agreement with that predicted by R. E. Lingenfelter and E. S. Light et al. if the neutron energy spectrum has the shape calculated by L. L. Newkirk. The change in the neutron latitude dependence with the cosmic ray modulation agrees with the predictions of Lingenfelter and Light et al. For several solar proton events enhancements were observed in the neutron counting rates at $\lambda \geq 70°$. Such events, however, provide an insignificant injection of protons at $E \leq 20$ Mev into the radiation belts. An isotropic angular distribution of the neutron leakage in the energy range 0.1 kev to 10 Mev best fits the observed altitude dependence of the neutron leakage flux. (auth)

4398 OBSERVATION OF RELATIVISTIC ELECTRON PRECIPITATION AT L=6. Matthews, D.L.; Simons, D.J. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). J. Geophys. Res. 78: No. 31, 7539-7542 (1 Nov 1973).

This is a first report of detailed observations of electrons ranging in energy from 50 to 1000 kev in a relativistic electron precipitation (REP) event at L=6 and local magnetic time~09h. (auth)

4399 UPWARD BIRKELAND CURRENTS. Rassbach, M.E. (Space Science Department, Rice University, Houston, Texas 77001). J. Geophys. Res. 78: No. 31, 7553-7557 (1 Nov 1973).

The purpose of this note is to show that conservation of the magnetic moment (first invariant) for magnetospheric electrons implies that upward-moving positive ions will generally carry the bulk of upward currents above 1 to 2 R_E, rather than the downward-moving electrons at first expected to do so because of greater electron mobility. This constraint takes strongest effect on higher L value field lines if we assume that there is little cold plasma on these lines and that pitch angle scattering is weak. It is likely that even 3-eV electrons are too energetic to relax this constraint. (auth)

4400 COMMENTS ON THE PAPER 'THE INTERNAL STRUCTURE OF THE GEOMAGNETIC NEUTRAL SHEET' BY K. SCHINDLER AND N. F. NESS. Russell, C.T. (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024). J. Geophys. Res. 78: No. 31, 7576-7579 (1 Nov 1973).

Several alternative interpretations of the distribution of field values observed by Explorer 34, which do not require the presence of neutral points are presented. (auth)

4401 RADAR OBSERVATIONS OF TWO-DIMENSIONAL TURBULENCE IN THE EQUATORIAL ELECTROJET. Balsley, B.B. (NOAA Research Laboratories, Boulder, Colorado 80302); Farley, D.T. J. Geophys. Res. 78: No. 31, 7471-7479 (1 Nov 1973).

Radar studies at 50 MHz of irregularities in the electrojet have been made at the Jicamarca Observatory with much better spatial and temporal resolution than that in the past. The Doppler spectra of the signals reveal a complicated and rapidly varying structure, which was masked by the crude resolution of earlier measurements. The present results strongly support the idea that the small-scale irregularities observed by the radar are generated by a two-dimensional coupling process in which large-scale irregularities, generated by the gradient drift plasma instability, in turn generate small irregularities traveling in other directions via either the gradient drift or the two-stream instability. (auth)

4402 STRUCTURE OF HIGH-LATITUDE IRREGULAR ELECTRON FLUXES AND ACCELERATION OF PARTICLES IN THE MAGNETOTAIL. Hruška, A. (Division of Physics, National Research Council of Canada, Ottawa, Ontario, Canada). J. Geophys. Res. 78: No. 31, 7509-7514 (1 Nov 1973).

The intensity of high-latitude substorm-associated fluxes (S fluxes) of electrons ($E > 10$ kev) observed on the polar-orbiting satellites Isis 1 and 2 varies irregularly with invariant latitude. Sharp peaks in the latitude profiles of the S fluxes are characterized by strongly reduced anisotropy in the pitch angle distribution. The ansiotropy increases monotonically with decreasing intensity of fluxes; variations of the anisotropy with invariant latitude are irregular. The spectrum of electrons in the S fluxes is softest in the intensity peaks. Characteristic features of boundary 'spikes' in the latitude profiles of electron fluxes are similar to the features of peaks in the S fluxes. It is suggested that electrons are energized mainly along isolated lines in the tail magnetic field and that the observed structure of the S fluxes is probably due to the presence of several χ-type neutral points in the magnetotail. The structure of the S fluxes and boundary spikes cannot be explained by acceleration mechanisms that conserve the first adiabatic invariant. (auth)

4403 OBSERVATIONS OF STORM-ASSOCIATED LOW-ENERGY PROTONS, ALPHA PARTICLES, AND $Z \geq 3$ NUCLEI WITHIN THE MAGNETOSPHERE ON MARCH 8, 1970. Verzariu, P. (Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland 20910). J. Geophys. Res. 78: No. 34, 8367-8372 (1 Dec 1973).

Measurements of low-energy protons (0.3–1.4 Mev), alpha particles, and $Z \geq 3$ nuclei (≥ 0.3 Mev/nucleon) during the solar particle event that began on March 6, 1970 are presented. The data were obtained by the polar-orbiting Injun 5 satellite at the maximum intensity phase of the event on March 8, 1970. (AIP)

4404 AURORAL ELECTROJETS AND EVENING SECTOR ELECTRON DROPOUTS AT SYNCHRONOUS ORBIT. Erickson, K.N. (Department of Physics, Augsburg College, Minneapolis, Minnesota 55404); Winckler, J.R. J. Geophys. Res. 78: No. 34, 8373-8380 (1 Dec 1973).

Evidence is presented that supports the concept that, during magnetospheric substorms, ionospheric auroral electrojet currents are directly coupled to the proton partial ring current in the outer magnetosphere. We have studied the relationship between the 150- to 1000-kev electron behavior at the synchronous orbit at 6.6 R_E and the auroral electrojet index AE during periods of substorm activity. (AIP)

4405 OBSERVATION OF ELECTRONS AT MID-LATITUDE DURING A MAGNETIC STORM. Tuohy, I.R.; Harries, J.R. (Department of Physics, University of Adelaide, Adelaide, South Australia). J. Geophys. Res. 78: No. 34, 8381-8386 (1 Dec 1973).

Electrons with an energy near 25 kev were detected during an X ray astronomy flight from Woomera, South Australia, at 0030 hours UT on July 10, 1970. The rocket was launched in the presence of a magnetic storm (this condition was required for the primary experiment). The electrons were found to have a strong pitch angle dependence and a steep energy spectrum. No electrons were detected at or below an altitude of 130 km. The electrons may have been a result of the geomagnetic activity at the time of the flight, although the weak flux measured could also be part of the permanent inner radiation belt. The implications of an electron flux during an X ray astronomy flight are discussed. (AIP)

4406 AURORAL ELECTRON SPECTRA. Rees, M.H. (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado 80302); Maeda, K. J. Geophys. Res. 78: No. 34, 8391-8394 (1 Dec 1973).

The differential electron flux as a function of penetration depth is determined. (AIP)

4407 CYCLOTRON RESONANCE WAVE AMPLIFICATION IN THE MAGNETOSPHERE AND ENERGETIC PARTICLE STABILITY. Lucas, C.; Brice, N. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850). J. Geophys. Res. 78: No. 34, 8338-8344 (1 Dec 1973).

Detailed electron distribution measurements in the outer magnetosphere now available indicate that the energetic electron anisotropy may be very energy dependent, there being positive anisotropies near the magnetic equator for low-energy particles and negative anisotropies in this region for high-energy particles. Previous wave growth calculations assuming the energetic particle anisotropy to be independent of energy are inacurrate at high energies. The net one-hop whistler mode wave amplification is calculated as a function of frequency for a measured electron distribution at L=7 for a number of assumed equatorial plasma densities. It is found that an increase in cold plasma density results in a change from a net wave damping to significant wave amplification. (auth)

4408 DEVELOPMENT OF THE AURORAL ABSORPTION SUBSTORM. Fjordheim, O.; Henriksen, K. (Auroral Observatory, Tromsoe, Norway). J. Atmos. Terrest. Phys.; 36: No. 5, 811-820(May 1974).

This work is basically a statistical analysis of 60 observed AA substorms. The temporal and geographical development is obtained as function of substorm time. Dominating features such as geographical extent, eastward and westward expansions, corotation of the morning max absorption intensity with the Earth and correlations between absorption intensity and magnetic and solar activity are found and must be taken account of in future substorm modelling. (auth)

4409 SYNCHROTRON RADIATION FROM DRIFTING MAGNETOPLASMA. Shukla, P. K.; Singh, R. P.; Singh, K. P.; Singh, R. N. (Oesterreichische Akademie der Wissenschaften, Vienna). Int. J. Electron.; 36: No. 3, 393-398(Mar 1974).

The effects of the drift motion of the plasma on the radiated synchrotron power are studied in detail with special reference to the magnetospheric and solar coronal plasmas. It is shown that the radiated power is enhanced in the presence of the drifting plasma. (auth)

4410 INITIAL EXPANSION PHASE OF AN ARTIFICIALLY INJECTED ELECTRON BEAM. Gendrin, R. (Univ. of California, La Jolla, San Diego). Planet. Space Sci.; 22: No. 4, 633-636(Apr 1974).

The expansion of an electron beam (E = 20 keV, I = 1 A) artificially injected into the magnetosphere at a high latitude (~60°) is considered. It is shown that, although the space charge effects play an important role during the initial phase of the expansion, it is the magnetic field at the place of the injection which governs the beam radius and the beam density. For an injection parallel to the magnetic field, the ratio between the beam kinetic energy density and the magnetic energy when the beam passes through the Equator, may reach important values (~2 to 5). However, taking into account possible beam instabilities could strongly modify this conclusion. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 4026.

4411 (AD-770608) SOVIET DEVELOPMENT OF NEEDLE-TIP FIELD-EMISSION CATHODES FOR HIGH-CURRENT ELECTRON BEAMS. Kassel, S.; Hendricks, C. D. (Rand Corp., Santa Monica, Calif. (USA)). Aug 1973. Contract DAHC15-73-C-0181. 24p. NTIS $2.75.

Recent Soviet theoretical and experimental work on cathodes for very high-current charged particle beams is summarized. Field emission from needle-tip cathodes is based on explosive emission from the tips, accompanied by explosion-derived plasma setting up intense local electric fields. A cathode fabrication method is described that gives stable operation through 10,000 to 100,000 pulses of about 3 nanoseconds each, for currents of 500 to 1000 A. A liquid cathode produces stable current pulses within 6 percent of 2000 A. In a large needle array, 80 percent to 100 percent of the tips maintained current value dispersion within 20 percent. Operational cathodes of the controllable tip-and-dielectric type have been developed for 500 keV and 50 kA, and of the multiple-tip types for 1 MeV and 50 kA. (GRA)

4412 (JINR-P14-7754) HEAVY-ION BEAMS APPLIED IN PRACTICE. Flerov, G. N.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 56p. (In Russian). Dep. NTIS (U. S. Sales Only) $6.00.

Different cases of heavy-ion-beam application in related sciences and technologies are considered; namely, in solving the problems of solid state physics, in study of materials, in biology, and for preparation of "nuclear filters" unique in their properties. (18 figures, 1 table) (auth)

4413 (JUL-1032-NC) NEGATIVE HALOGEN ION GUN FOR LOW ENERGIES. Kashihira, N.; Vietzke, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). Dec 1973. 39p. Dep. NTIS (US Sales Only) $5.00.

A simple and inexpensive negative halogen ion gun has been developed combining surface ionization and a multistaging lens system for collision dynamic studies. The ion gun delivers about 10^{-8} A of negative chlorine ions with energies ≥10 eV and an energy spread between 30 and 10%. For smaller intensities the energy spread of the negative ions is 0.6 eV, corresponding roughly to twice the thermal spread of a hot emitter surface at 1700°K. The ions are free from the other ionic impurities and are in the electronic ground state. (auth)

4414 SECONDARY MOLECULAR ION EMISSION FROM SOME CuBe AND CuAl ALLOYS. Leleyter, M.; Joyes, P. (Paris Univ., Orsay, France). J. Phys., B (London); 7: No. 4, 516-528 (11 Mar 1974).

Experimental results are given on cluster ions sputtered by primary ion bombardment from some CuBe and CuAl alloys. Emission intensities of these aggregates present alternations according to the parity of the number of Cu atoms: Cu_nBe_m cluster ions behave as Cu_n^+ ions with enhancement of n odd numbered ions; Cu_nAl_p cluster ions are found to be favored when n + p is odd. These intensity maxima and minima are related to the external electronic structure and an attempt is made to explain this peculiar behavior from the Hueckel model. (auth)

4415 SPUTTERING STUDIES USING THE MATRIX ISOLATION TECHNIQUE. Green, D.W.; Gruen, D.M.; Schreiner, F.; Lerner, J.L. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Appl. Spectrosc. 28: No. 1, 34-38 (Jan 1974).

The application of the matrix isolation technique to the study of the sputtering process is reported. Equations are derived which relate the experimentally measured absorbance data to the sputtering yield. These equations are applied to data from the sputtering of Nb metal by 50 keV rare gas ions. Relative sputtering yields obtained in this manner are in good agreement with sputtering yields obtained by weight loss measurements. The potential of the technique for studies of both physical and chemical sputtering and for the determination of oscillator strengths is discussed. (auth)

4416 IDENTIFICATION OF SOME PEAKS IN THE SPECTRUM OF CHARACTERISTIC ELECTRON ENERGY LOSSES IN TUNGSTEN. Chaikovskii, E.F.; Red'kin, V.S.; Zashkvara, V.V.; Sotnikov, V.T. Sov. Phys.-Solid State 15: No. 6, 1307-1307 (Dec 1973).

High resolution energy loss spectra of 600 ev electrons scattered from oxygen atmosphere cleaned tungsten foil samples at 2×10^{-6} torr produce plasma-loss peaks which permit more definitive assignment of energies of plasma excitations in tungsten and in its surface oxide film. (AIP)

4417 THEORETICAL AND EXPERIMENTAL STUDY OF THE DUOPLASMATRON ION SOURCE. I. Model of the Duoplasmatron Discharge. Lejeune, C. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 116: No. 3, 417-428(1974).

The duoplasmatron ion source is extensively used in many domains of experimental physics. In spite of a number of publications about this source, its elementary mechanisms are not yet well understood and no similarity rules are available. These problems have to be solved in order to improve the source properties and to provide the optimum conditions to adapt the extracted ion beam to a device for a particular application. An exhaustive study of the different plasmas of the discharge has allowed us to explain the physical processes governing the behavior of the arc with a "dual" compression: geometrically and magnetically; they are discussed briefly. The analysis of the dynamics of the charged particles allows us to propose a one-dimensional static theory of the discharge; its basis and main results—important for the derivation of the source properties—are presented and then compared to experiment and reasonable agreement is observed. Such a model may also be adapted to the magnetized discharge used in certain other ion sources. (auth)

4418 THEORETICAL AND EXPERIMENTAL STUDY OF THE DUOPLASMATRON ION SOURCE. II. Emissive Properties of the Source. Lejeune, C. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 116: No. 3, 429-443(1974).

The theoretical variations of the properties of the ion beam extracted from a duoplasmatron source are derived from a model of the discharge and then compared with experiment. Satisfactory agreement is observed for the influence of the operating parameters as well as for that of the geometric parameters on the ion beam intensity, the ion beam composition, and the ionization efficiency; similarity rules of the source are derived. From these results, the optimum parameters of the source may be determined, according to the requirements of any particular application. (auth)

4419 ION EXCITED AUGER SPECTRA OF ALUMINUM. Haas, T. W. (Aerospace Research Labs., Wright-Patterson AFB, OH); Springer, R. W.; Hooker, M. P.; Grant, J. T. Phys. Lett.; 47A: No. 4, 317-318(8 Apr 1974).

An Auger spectrum from aluminum was detected for the first time using argon ion bombardment as the method for excitation. The Auger spectral line shape differs from that obtained using electron excitation. (auth)

4420 ROLE OF INELASTIC PROCESSES IN THE SECONDARY ELECTRON EMISSION OF LIGHT ELEMENTS. Matskevich, T. L.; Kazantsev, A. P. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2499-2501(Dec 1973). (In Russian).

The role of inelastic processes in the change of the direction of movement of electrons and in the creation of inelastically reflected electrons from massive targets and thin films is examined. A method is proposed for the determination of the efficiency of the inelastically reflected electrons in the creation of slow secondary electrons. (tr-auth)

4421 ELASTIC REFLECTION OF ELECTRONS AND SECONDARY ELECTRON EMISSION OF CsI AT LOW ENERGY OF THE PRIMARY ELECTRON. Afanas'ev, A. G.; Bronshtein, I. M. (Leningrad State Pedagogical Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2492-2494(Dec 1973). (In Russian).

It is shown that in the energy range of primary electrons from 1 to 30 eV, the mean free path of the reflected electrons is sharply reduced with increase of their energy from 4 to 8 eV. (tr-auth)

Atomic and Molecular Properties

Refer also to abstracts 4478 and 4493.

4422 OBSERVATION OF COHERENT ELECTRON-DENSITY-DISTRIBUTION OSCILLATIONS IN COLLISION-AVERAGED FOIL EXCITATION OF THE n=2 HYDROGEN LEVELS. Sellin, I.A.; Mowat, J.R.; Peterson, R.S.; Griffin, P.M.; Laubert, R.; Haselton, H.H. (University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. Lett. 31: No. 22, 1335-1337 (26 Nov 1973).

Using foil-excited H beams (80-400 keV) we have applied a simple technique recently proposed by Eck to unambiguously separate genuine excitation coherence from that induced by fine structure and

probe fields. We find compelling evidence for strong excitation coherence and have studied quantities related to the collision-averaged s-p phase coherence angle. Using Eck's theory, the data exhibit coherent fore-aft oscillations of the electron cloud with respect to the proton. (auth)

4423 HYPERFINE STRUCTURE IN THE ^{253}Es EMISSION SPECTRUM. III: EXTENSION OF THE LINE LIST, LEVELS OF Es I AND Es II, NUCLEAR MAGNETIC-DIPOLE AND QUADRUPOLE MOMENTS. Worden, E.F.; Lougheed, R.W.; Gutmacher, R.G. (Lawrence Livermore Laboratory, Livermore, California 94550); Conway, J.G. J. Opt. Soc. Am. 64: No. 1, 77-85 (Jan 1974).

New observations of the einsteinium emission spectrum have increased the number of observed lines from 53 to 290 in the wavelength range 2600-6900 Å. Ten lines have been assigned as transitions to the $5f^{11}7s^2$ $^4I_{15/2}$ ground state of Es I on the basis of reversal and hyperfine structure. The next odd level is $^4I_{13/2}$ at 8759.25 cm^{-1}. The lowest even level is $^6I_{15/2}$ of the $5f^{11}7s7p$ configuration at 17802.89 cm^{-1}. The lowest level of the $5f^{10}6d7s^2$ configuration is $^4I_{17/2}$ at 19367.93 cm^{-1}. Fifteen lines are classified as transitions between Es I levels. Twenty-three lines are assigned as transitions to the two known lowest levels of Es II. The hyperfine constants $a_{5f} = 0.033 \pm 0.001$ cm^{-1} and $b_f = 0.48 \pm 0.06$ cm^{-1} have been derived by an analysis of the hyperfine structure of assigned Es II lines. From these constants for ^{253}Es, we obtained a nuclear magnetic dipole moment of $+3.6 \pm 0.4\mu_N$ and a quadrupole moment of $+6.0 \pm 0.8$ b. (auth)

4424 THEORETICAL STUDIES OF HYDROGEN RARE GAS COMPLEXES: He_nH AND He_nH^+ CLUSTERS. Milleur, M.B.; Matcha, R.L. (Chemistry Department, The University of Houston, Houston, Texas 77004); Hayes, E.F. J. Chem. Phys. 60: No. 2, 674-679 (15 Jan 1974).

Results of LCAO-SCF-MO calculations of the ground states of He_nH and He_nH^+ clusters ($n = 1$-4) are presented and discussed. A potential energy surface is reported for the collinear He_2H^+ system and for selected nonlinear arrangements. The relative stability of the various complexes is explored, and some preliminary excited state calculations are reported. Based on these calculations a speculation is made regarding the possible identity of the matrix isolated species responsible for the infrared bands observed by Bondybey and Pimentel in certain hydrogen-rare gas mixtures. (auth)

4425 ENERGY SHIFTS OF K X-RAY LINES FOR DIFFERENT CHEMICAL COMPOUNDS OF Ru, Pr, AND Yb. Lee, P.L.; Boehm, F.; Vogel, P. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. A 9: No. 2, 614-621 (Feb 1974).

The energy shifts of $K\alpha_2$, $K\alpha_1$, $K\beta_3$, $K\beta_1$, and $K\beta_2$ x rays were measured for the following Ru, Pr, and Yb compounds: Ru, $Ru(CO_2)Cl_2$, RuO_2, $[Ru(NH_3)_4OHCl]Cl \cdot 2H_2O$, and RuF_3; Pr, PrC_2, Pr_2O_3, $PrFeO_3$, Pr_6O_{11}, PrO_2, $CsPrF_5$, and $CsPrF_6$; Yb, YbF_3, and Yb_2O_3. The results are compared with free-ion relativistic self-consistent-field calculations. The measurements bear out the dominant role of the 4f electrons in energy shifts between the trivalent and tetravalent Pr and the divalent and trivalent Yb. In Yb the full free-ion value is observed, while in Pr the free-ion value appears to be attenuated by a factor of 0.4, presumably owing to covalency. In all cases the relation of the x-ray energy shift to the Mössbauer isomer shift is discussed. (auth)

4426 EXCITATION-ENERGY-DEPENDENT FEATURES IN THE CONTINUUM SPECTRUM OF CERIUM NEAR THE Mα AND Mβ X-RAY EMISSION LINES. Chamberlain, M.B. (Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio 45433); Burr, A.F.; Liefeld, R.J. Phys. Rev. A 9: No. 2, 663-667 (Feb 1974).

M-series x-ray emission spectra from cerium have been recorded for near-threshold electron excitation. For incident electron energies near the M_V and M_{IV} inner-shell ionization energies, the spectra are dominated by intensity resonances of structures which are part of the continuous spectrum near its high-frequency limit. The intensity and position dependencies of the resonating structures are presented and are interpreted as arising from resonances in the cross sections for scattering electrons into empty 4f levels. No such resonances were observed for excitation energies near the M_{III} and M_{II} inner-shell ionization energies. (auth)

4427 FADDEEV APPROACH TO ATOMIC THREE-BODY PROBLEMS. Dodd, L.R. (Department of Mathematical Physics, University of Adelaide, Adelaide, South Australia 5001, Australia). Phys. Rev. A 9: No. 2, 637-643 (Feb 1974).

The Faddeev equations for the (e⁻, H) system have been solved numerically using separable expansions for both screened and unscreened versions of the Coulomb t matrix. By considering the equations in uncoupled form, the convergence behavior of the binding energy and the singlet scattering length have been examined as the number of terms in the representation of the electron-electron potential has been increased. One to three states have been included in the e-p interaction and up to twenty states in the e-e interaction. Although the unscreened values are reasonable in low orders of truncation, the convergence is poor as more terms are included in the separable representations. To improve the rate of convergence, a screened form of the Coulomb t matrix based on the Sturmian expansion of the Hulthén potential has been introduced. In the lowest truncation of the e-p system, strong shielding of the e-e interaction is necessary and convergence of both the binding energy and the scattering length can be achieved. In higher truncations of the e-p system, where the representation of the e-p interaction is more realistic, shielding is not effective in improving the rate of convergence within the practical limits of the calculations. The implications of the present calculations for the Faddeev approach to atomic three-body problems are discussed. (auth)

4428 SPLITTING OF THE $4d_{3/2}$ AND $4d_{5/2}$ LEVELS IN THE RARE-EARTH ELEMENTS AND THEIR OXIDES. Salem, S.I.; Scott, B.L. (Department of Physics-Astronomy, California State University Long Beach, Long Beach, California 90840). Phys. Rev. A 9: No. 2, 690-696 (Feb 1974).

Systematic measurements have been made on the $L\beta_{2,15}$ [L_3-$N_{4,5}$] and the $L\gamma_1$[L_2-N_4] x-ray emission lines of the rare earths: $_{59}$Pr, $_{60}$Nd, $_{62}$Sm, $_{63}$Eu, $_{64}$Gd, $_{65}$Tb, $_{66}$Dy, $_{67}$Ho, $_{68}$Er, $_{69}$Tm, and $_{70}$Yb. Each element was studied both in the metallic and oxidized states. The exchange interaction between the 4f and the 4d electrons splits both levels and results in sets of x-ray emission lines that are characteristic of the rare-earth elements alone, and that appear at the low-energy sides of the $L\beta_{2,15}$ and $L\gamma_1$ lines. A computer program was devised to unfold the complex structures, in order to obtain the energy separation and relative transition probabilities of the constituent lines. The effect of oxidation on the splitting of the 4d levels, although insignificant for low- and high-Z elements, was found to be more than expected for elements with atomic number in the neighborhood of 65. It is quite possible that the structures studied consist of more than two discrete emission lines; that is, each of the 4d levels splits into more than two levels, especially in the low-atomic-number elements. A theoretical interpretation of these results as a simple exchange interactions does not fit the results satisfactorily, so that more theoretical work is needed. (auth)

4429 THEORETICAL X-RAY TRANSITION PROBABILITIES FOR HIGH-Z SUPERHEAVY ELEMENTS. Anholt, R. (Department of Chemistry and Yale Heavy Ion Accelerator Laboratory, Yale University, New Haven, Connecticut 06520); Rasmussen, J.O. Phys. Rev. A 9: No. 2, 585-592 (Feb 1974).

K and L x-ray transition probabilities have been calculated for several elements between Z=92 and Z=170. The calculations include multipoles higher than E1, are relativistic, and utilize Dirac-Hartree-Fock wave functions with finite-size nuclei. At these very high atomic numbers, many transition rates go through a maximum as a function of Z, and other transitions show a maximum and a minimum, and then begin to increase again past Z=150. (auth)

4430 HYPERFINE STRUCTURE AND ISOTOPE SHIFT OF 3.5-h ^{193}Hg BY A ZEEMAN-SCANNED OPTICAL-PUMPING METHOD. Fulop, G.F.; Liu, C.H.; Moskowitz, P.A.; Redi, O.; Stroke, H.H. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 9: No. 2, 593-605 (Feb 1974).

A new method, suggested by the work of Otten, involving Zeeman scanning of an optically pumped vapor has been developed and used to determine the hyperfine structure (hfs) of 3.5-h ^{193}Hg ($I = 3/2$) in the $6s6p\ ^3P_1$ state, and the isotope shift in the 2537-Å resonance line. The $6s^2\ ^1S_0$ ground state is optically pumped via each of the hfs components. The displacements of the ^{193}Hg hfs components from ^{198}Hg are found by measuring the magnetic field used to scan the optical-pumping lamp. The resonance is detected optically. The measured values are 83(4), 572(5), and 911(5) mk for the F=5/2, 3/2, and 1/2 components, respectively. The final results are 80(7) and 572(5) mK for the positions of the first two components corrected to account for perturbations caused by the presence of other isotopes. These perturbations are much smaller than the ones encountered in optical spectroscopy because of the selective nature of our detection method. A model calculation for the relevant emission and absorption processes was developed to determine the perturbations. We obtain, with the use of the previously determined A value, the corrected quadrupole interaction constant $B = +15(7)$ mK. The corrected isotope shift of ^{193}Hg relative to ^{198}Hg is 383(7) mK. The resulting corrected odd-even staggering parameter, relative to ^{192}Hg and ^{194}Hg, is $\gamma = 0.74(30)$ or 0.56(14), the two values corresponding to different measurements of the isotope shift of ^{192}Hg. (auth)

4431 SPIN-ROTATION INTERACTION AND MAGNETIC SHIELDING IN $^1\Sigma$ MOLECULES. Reid, R.V. Jr.; Chu, A.H. (Department of Physics, University of California, Davis, California 95616). Phys. Rev. A 9: No. 2, 609-613 (Feb 1974).

The theory of the spin-rotation interaction is discussed and its relation to the paramagnetic part of the magnetic shielding tensor derived with consistent treatment of the electric field in the molecule. The latter point yields agreement between theory and experiment for the first time in the case of isotopes of the hydrogen molecule. The

paramagnetic part of the shielding constant for H_2 ($J = 1$) is found to be $-5.66(6) \times 10^{-4}$ in the gauge where the vector potential is zero at the nucleus. (auth)

4432 L SUBSHELL FLUORESCENCE YIELDS AND COSTER–KRONIG TRANSITION RATES AT Z = 88 AND 94. Campbell, J. L. (Univ. of Guelph, Ont.); McNelles, L. A.; Geiger, J. S.; Graham, R. L.; Merritt, J. S. Can. J. Phys.; 52: No. 6, 488-498(15 Mar 1974).

The L_2 and L_3 subshell fluorescence yields, ω_2 and ω_3, and the Coster–Kronig transition probability f_{23} in ^{88}Ra and ^{94}Pu were deduced from conversion electron L x-ray coincidence measurements. The Chalk River $\pi\sqrt{2}\beta$-spectrometer was used to select the conversion electrons. X rays were detected in a Si(Li) counter which was calibrated for absolute x-ray detection efficiency. The results are as follows: Z 88 and 94 ω_2: 0.498 ± 0.027, 0.485 ± 0.026, ω_3: 0.438 ± 0.022, 0.484 ± 0.017, f_{23}: 0.102 ± 0.006, 0.229 ± 0.004, respectively. (auth)

4433 ENERGY LEVELS OF NEUTRAL HELIUM (^{4}He I). Martin, WC. (Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234). J. Phys. Chem. Ref. Data 2: No. 2, 257-265 (1973).

This compilation of all identified levels is based on the most accurate available observations. It includes 48 levels above the He II 1^2S limit (two-electron excitation). (auth)

4434 PRODUCTION OF THE STIMULATED RAMAN LINES IN H_2 GAS WITH A FOCUSED LASER BEAM. Hsieh, C.T.; Foltz, N.D.; Cho, C.W. (Department of Physics, Memorial University of Newfoundland, St. John's Newfoundland, Canada). J. Opt. Soc. Am. 64: No. 2, 202-205 (Feb 1974).

The laser power threshold for the forward- and back-scattered $Q_1(1)$ and $S_0(1)$ stimulated Raman lines from H_2 gas in the pressure range 4–40 amagats was measured for the focused-beam geometry. This work was undertaken to obtain quantitative data on the threshold power in the neighborhood of Dicke narrowing zones, and to determine the relationship between the threshold-power behavior and theoretical gains for the focused-laser-beam configuration. Our results indicate a strong dependence of the $S_0(1)$ line on laser polarization; the threshold power is a minimum for a circularly polarized beam. Threshold powers for the $Q_1(1)$ were similar for both linearly and circularly polarized laser light. The density dependence of the threshold power for both of the stimulated Raman lines was observed to be identical in both forward and backward directions. The predicted behavior of the threshold power is compared with the observed data. (auth)

4435 QUANTUM ELECTRODYNAMICAL CORRECTIONS TO THE FINE STRUCTURE OF HELIUM. Douglas, M.; Kroll, N.M. (Department of Physics, University of California at San Diego, La Jolla, California 92037). Ann. Phys. (N.Y.) 82: No. 1, 89-155 (Jan 1974).

Order α^4mc^2 corrections to the fine structure of the deepest triplet P state ($2^3P_{0,1,2}$) of the He-4 atom have been investigated. The investigation is on the covariant Bethe-Salpeter equation including external potential to take account of the nuclear Coulomb field. All order α^4mc^2 corrections which arise from Feynman diagrams involving the exchange of one, two, and three photons, as well as radiative corrections to the electron magnetic moment have been found. The results are presented in a form suitable for computerized numerical evaluation. (auth)

4436 IDENTIFICATION OF A SECOND RESONANT STATE OF H^{2-}. Thomas, L. D. (International Business Machines Corp., San Jose, CA). J. Phys., B (London); 7: No. 4, L97-L98(11 Mar 1974).

A previous calculation (Taylor and Thomas (Phys. Rev. Lett.; 28: 1091 to 1092 (1972))) suggested the existence of a second resonant state of H^{2-} which was since observed experimentally at 17.2 eV (Peart and Dolder (J. Phys. B. Atom. Molec. Phys.; 6: 1497-1502 (1973))). A new analysis of the calculated data yields a state which is 60% $(2p)^3$ and 20% $(2s)^2(2p)$ with an energy of 17.26 eV. (auth)

4437 CORRELATION EFFECTS IMPORTANT FOR ACCURATE OSCILLATOR STRENGTHS. Fischer, C. F. (Univ. of Waterloo, Ont.). J. Phys., B (London); 7: No. 4, L91-L96(11 Mar 1974).

It is shown that the oscillator strengths for several transitions in He are more accurate in the MCHF than the HF approximation and that this improvement cannot be attributed to the charge distribution function. The important configurations are those which contribute significantly to the state under consideration and at the same time, have an allowed transition to the dominant configuration of the other state. Thus all external correlations may be important in the accurate determination of oscillator strengths. (auth)

4438 COMMENT ON THE SINGLE-TRIPLET SPLITTING OF HeI-LIKE SPECTRA. Chang, T. N. (Univ. of Chicago). J. Phys., B (London); 7: No. 4, L108-L110(11 Mar 1974).

It is shown, both qualitatively and quantitatively, that the n dependence of the singlet-triplet splitting of the singly excited HeI-like spectra follows the theoretical law $\Sigma_{\nu=0}^{1}(av(1,Z)/n^{2\nu+3})$ in contrast to the n^{-2} dependence suggested empirically by Elden and Löfstrand (J. Phys. B. Atom. Molec. Phys.; 3: 1380-8 (1970)) and Löfstrand (Physica Scripta; 8: 57-61 (1973)). (auth)

4439 INFLUENCE OF ION DYNAMICS ON Hα AND Hβ AT LOW DENSITIES. Cooper, J.; Smith, E. W.; Vidal, C. R. (Joint Inst. for Lab. Astrophysics, Boulder, CO). J. Phys., B (London); 7: No. 4, L101-L105(11 Mar 1974).

Calculations for the Stark broadening of Hα and Hβ using a unified theory for both ions and electrons are presented in the density range 10^{14} to 10^{15} cm^{-3} at a temperature of 10^4 K. Although the theory is of marginal validity at these densities, it shows quite conclusively the influence of ion dynamics in reducing the dip at the center of the Hβ profile and the peak in the center of the Hα profile. (auth)

4440 OBSERVATION OF VIBRATIONAL TRANSITIONS IN $(^3He^3H)^+$ AFTER β-DECAY IN THE TRITIUM MOLECULE. Raitz Von Frentz, R.; Luchner, K.; Micklitz, H.; Wittwer, V. (Technische Univ., Munich). Phys. Lett.; 47A: No. 4, 301-302(8 Apr 1974).

An infrared emission band was observed at (4.69 ± 0.03) μ as a consequence of β-decay in molecular tritium [$^3H_2 \xrightarrow{\beta^-} (^3He^3H)^+$] at 25 K. This emission is due to β-recoil-induced vibrational excitation. (auth)

4441 IONIZING COLLISIONS OF THE METASTABLE AND LONG-LIVED HIGHLY EXCITED STATES OF HELIUM ATOMS WITH WATER VAPOR. Shibata, T.; Fukuyama, T.; Kuchitsu, K. (Tokyo Univ.). Shitsuryo Bunseki; 21: No. 3, 217-221(Sep 1973).

Long-lived excited states of $He^*(2^1S$ and $2^3S)$ and He^{**}(in highly excited states), produced by impact of 20 ~ 200 eV electrons were allowed to collide with H_2O and D_2O molecules. It was confirmed that ions H^+, HeH^+, OH^+ and H_2O^+ were produced by impact of He^* with H_2O. An ion produced by a rearrangement chemi-ionization, HeH^+, was identified for the first time in the $He^* + H_2O$ system. Another process, where H^{**} is ionized into He^+ by collision with H_2O, was also observed. These processes were discriminated by the difference in the threshold energies of the electrons used for exciting the helium atoms. The corresponding deuterated ions were observed when D_2O was used for the target. (auth)

4442 1S–2S EXCITATION OF FAST He^+ IONS IN PASSAGE THROUGH GASES. Shah, M. B.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 4, L122-L124(11 Mar 1974).

Cross sections σ_{11^*} for the formation of $He^+(2S)$ metastable ions by excitation of 10 to 40 keV He^+ ions in passage through He, Ar, Kr, H_2, N_2 and O_2 were determined. These cross sections are strongly energy dependent but are at least two orders of magnitude smaller than corresponding cross sections σ_{21} for $He^+(2S)$ formation in electron capture by He^{2+} ions. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 4528, 4646, 4712, 5043, 5055, 5095, and 5099.

4443 VACUUM POLARIZATION IN HIGH-Z, FINITE-SIZE NUCLEI. Rinker, G.A. Jr. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Wilets, L. Phys. Rev. Lett. 31: No. 26, 1559-1562 (24 Dec 1973).

We have calculated vacuum-polarization charge densities to all orders $(Z\alpha)^n\alpha$ for realistic nuclei of finite extent. In muonic Pb, orders $n \geq 3$ contribute -34 ± 2 eV to the $5g$–$4f$ transitions, compared with the point nucleus value of −50 eV. This increases the discrepancy (first reported by Dixit et al.) to E(theor)–E(expt) $= 57 \pm 18$ eV ($5_{g9/2}$ –$4f_{7/2}$) and 72 ± 21 eV ($5_{g7/2}$–$4f_{5/2}$). Contributions to low-lying states show nearly an order-of-magnitude reduction. (auth)

4444 QUENCHING OF POSITRONIUM IN NITROGEN DIOXIDE. Chuang, S.Y.; Tao, S.J. (The New England Institute, Ridgefield, Connecticut 06877). Phys. Rev. A 9: No. 2, 989-992 (Feb 1974).

The quenching mechanism of positronium in NO_2 was investigated by measuring both positron lifetimes and two-photon angular-correlation curves of annihilating positron–electron pairs in NO_2 adsorbed on silica gel. It is found that instead of a conversion reaction by NO_2, chemical quenching is responsible for the quenching of positronium. The quenching cross section for NO_2 is compared with the conversion cross sections of O_2 and NO gases and also with the chemical quenching cross sections of Br_2 and I_2 molecules. The cross sections for chemical quenching are at least two to three orders of magnitude larger than the cross sections for conversion quenching of Ps. The bond strengths of

these molecules are found to play an important role in the Ps quenching process. (auth)

4445 TOTAL CROSS SECTIONS FOR THE SCATTERING OF POSITRONS BY HELIUM. Bransden, B. H.; Hutt, P. K.; Winters, K. H. (Univ. of Durham, Eng.). J. Phys., B (London); 7: No. 4, L129-L131(11 Mar 1974).

The consistency of recent measurements of total cross sections for positrons in helium is examined using forward dispersion relations. (auth)

4446 PENETRATION EFFECTS IN CONVERTED MUONIC TRANSITIONS. Raff, U.; Viollier, R. D.; Alder, K. (Univ. of Basel). Nucl. Phys.; A223: No. 3, 429-441(1974).

So far, when conversion coefficients have been introduced in the calculation of intensity ratios of muonic atoms, only the "no-penetration" approximation has been made. Firstly the theory of Auger coefficients is formulated including penetration effects, for both bound-bound and free-bound transitions, and secondly some special E1 transitions in muonic ^{205}Tl are investigated. The penetration effects describing the overlap of the muon transition charge and transition current densities with those of the converted electron are found to be rather important in magnitude. (auth)

4447 NEW RELATION BETWEEN MAGNETIC HYPERFINE STRUCTURE CONSTANTS FOR THE $1s_{1/2}$ AND $2p_{1/2}$ MUONIC ORBITS. Fujita, T.; Arima, A. (Tokyo Univ.). Phys. Lett., 49B: No. 2, 143-146(1 Apr 1974).

A new useful relation between magnetic h.f.s. constants for the $1s_{1/2}$ and $2p_{1/2}$ muonic orbits is derived by using the fact that a radial integral for the $1s_{1/2}$ orbit is similar to that for the $2p_{1/2}$ orbit inside nuclei, which is numerically confirmed. (auth)

4448 POSITRON ANNIHILATION IN DILUTE Fe-Al AND Fe-Si ALLOYS. Adonkin, V. T.; Dekhtyar, I. Ya.; Madatova, E. G.; Sakharova, S. G.; Fedchenko, R. G. (Inst. of Metal Physics, Kiev). Phys. Lett.; 47A: No. 4, 291-292(8 Apr 1974).

The effect of plastic deformation on positron annihilation in Fe-Al and Fe-Si alloys was investigated. The results are explained in terms of positron interaction with centers of two types as well as in terms of the subsequent positron trapping. (auth)

4449 INTERCEPTION EFFECT IN THE DAMPING OF THE π^- CAPTURE BY BOUND HYDROGEN. Petrukhin, V. I.; Risin, V. E.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 626-629(Mar 1974). (In Russian).

It is shown experimentally that along with the principal mesomolecular mechanism of damping of the pion capture by bound hydrogen there is also a damping caused by the capture of pions from the hydrogen atoms of the hydrogenous molecules to other atoms. (auth)

4450 K^--MESONIC AND BARYONIC ATOMS. Rook, J. R. pp 797-811 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The "surface" region of the nucleus as probed by mesons and baryons is considered. The exposition begins by discussing how to obtain information about the nucleon density from K^- mesic atoms. X-ray experiments are examined, but neither the Wycech [Nucl. Phys., B28, 541 (1971)] nor the Bardeen-Torigoe [Phys. Lett., 38B, 135 (1972)] approach is completely satisfactory, the former because it treats the relative energy incorrectly and the latter because it ignores the effect of the Pauli principle. Since it is important to get the energy right, the Bardeen method seems preferable. There are apparently no large differences between the true nuclear density and that calculated from the single-particle model for the radii involved in K^- mesic atoms. Since it is not possible to obtain information on the proton and neutron densities separately solely from analysis of x-ray yields, one must invoke other processes such as those with $\Sigma\pi$ channels. The present situation in the data analysis of these reactions is discussed. Other processes are also mentioned, such as the gamma rays following K^- capture. The work with baryonic atoms is much less advanced, but some remarks on it are made. (7 figures, 4 tables) (RWR)

4451 ENERGETICS OF THE POSITRONIUM OXIDATION PROCESS IN AQUEOUS SOLUTIONS OF INORGANIC IONS. Bartal, L. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Inorg. Nucl. Chem.; 36: No. 4, 922-924 (Apr 1974).

It is stated that several attempts were made to place the e^+/Ps (i.e., the positron-positronium couple) within the electrochemical series. An approach is described to assess the energetics of the process $Ps \rightarrow e^+_{aq} + e^-$ from kinematic experiments based on the reactions of Ps-atoms possessing excess kinetic energies with a variety of simple inorganic ions in aqueous solutions. (UK)

Collision Phenomena

Refer also to abstracts 4441, 5123, and 5733.

4452 (UPTEC-73-28-R) COMPARISON OF ALPHA-PARTICLES AND ^{16}O IONS AS BOMBARDMENT PARTICLES IN ION BACK-SCATTERING ANALYSIS. Petersson, S.; Tove, P. A.; Sundqvist, B.; Johansson, A. (Uppsala Univ. (Sweden)). May 1973. 22p. Dep. NTIS (US Sales Only) $4.25.

For material analysis by ion back-scattering spectrometry the quality of information depends on the type of ions used. Relevant quality factors are mass resolution, depth resolution, depth range of analysis and time of analysis. These factors are analyzed for two types of ions, alpha-particles and ^{16}O ions, considering optimum choice of the energy. For the chosen conditions the result is that ^{16}O ions give better mass and depth resolutions by factors approximately equal to 2.5 and approximately equal to 1.5 to 2, respectively. The depth of analysis for ^{16}O is about $^3/_5$ of that for alphas. The analysis counting rate for ^{16}O ions is about half of that for alphas. (auth) (Sweden)

4453 STUDY OF L-SUBSHELL IONIZATION OF Sm BY PROTONS: 0.3-2.0 MeV. Abrath, F.; Gray, T.J. (Department of Physics, North Texas State University, Denton, Texas 76203). Phys. Rev. A 9: No. 2, 682-689 (Feb 1974).

The L-subshell ionization processes in Sm for proton bombardment over the energy range of 0.3 to 2.0 MeV were studied using a thin Sm target (15.0 $\mu g/cm^2$). The total L-shell x-ray cross section and x-ray cross sections for the transitions Ll, $La_{1,2}$, Ly_1, and $Ly_{2,3}$ were determined at each proton energy. Calculations for the total L-shell x-ray and ionization cross sections and L-subshell ionization cross sections were performed for the nonrelativistic plane-wave Born approximation (PWBA), constrained-binary-encounter approximation (CBEA), and binary-encounter approximation (BEA). Comparisons of the theoretical predictions are made to the experimental values for the total L x-ray production cross section, total L-shell ionization cross section, relative intensities of the $La_{1,2}/Ll$, $La_{1,2}/Ly_1$, $La_{1,2}/Ly_{2,3}$, and $Ly_1/Ly_{2,3}$ ratios and the x-ray production cross sections for the $La_{1,2}$, $Ly_{2,3}$, and Ly_1 transitions. The results of this work show that the nonrelativistic PWBA theory is in reasonable agreement with the L_I-subshell processes measured in Sm for protons. The CBEA does not predict the appropriate structure observed in the L_I subshell. The BEA calculations show that there are major differences between the data for Sm and the predictions of that theory. (auth)

4454 MEASUREMENT OF THE RELATIVE CROSS SECTIONS FOR SIMULTANEOUS IONIZATION AND EXCITATION OF THE He^+ n = 4 LEVELS. Sutton, J.F. (Goddard Space Flight Center, Greenbelt, Maryland 20771); Kay, R.B.; Washington, A.U. D. C. Phys. Rev. A 9: No. 2, 697-703 (Feb 1974).

The relative cross sections for simultaneous ionization and excitation of helium by 200-eV electrons into the 4S, 4P, 4D, and 4F levels have been measured via a fast delayed-coincidence technique. Results are in poor agreement with Born-approximation calculations for simultaneous ionization and excitation of helium, the 4P component being larger than expected. (auth)

4455 INVERSION-SYMMETRY-CHANGING ATOM-ATOM COLLISIONS. Mittleman, M.H. (Physics Department, The City College of the City University of New York, New York, New York 10031). Phys. Rev. A 9: No. 2, 704-707 (Feb 1974).

Slow collisions of different isotopes of the same species are considered. The adiabatic representation of wave functions is used. There is no restriction to inversion-symmetry-conserving collisions because of the isotopic difference. Such parity-changing collisions are considered, and since levels of different parity can cross, it is shown that the cross sections may be large. The "switching functions," previously used, are shown to play an important role in this reaction and their interpretation is discussed. (auth)

4456 OPTICAL-POTENTIAL APPROACH TO THE ELECTRON-ATOM IMPACT-IONIZATION-THRESHOLD PROBLEM. Temkin, A. (Theoretical Studies Branch, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771); Hahn, Y. Phys. Rev. A 9: No. 2, 709-724 (Feb 1974).

The problem of the threshold law for electron-atom impact ionization is reconsidered as an analytic continuation of inelastic-scattering cross sections through the ionization threshold. The cross sections are evaluated from a distorted-wave matrix element, the final state of which describes the scattering from the Nth excited state of the target atom. The actual calculation is carried out for the e-H system, and a model is introduced in which the r_{12}^{-1} repulsion is replaced by $(r_1 + r_2)^{-1}$. This model is shown to preserve the essential properties of the problem

while at the same time reducing the dimensionality of the Schrödinger equation. Nevertheless, the scattering equation is still very complex. It is dominated by the optical potential which is expanded in terms of the eigenspectrum of QHQ. It is shown by actual calculation that the lower eigenvalues of this spectrum descend below the relevant inelastic-scattering thresholds; it follows rigorously that the optical potential contains repulsive terms. Analytical solutions of the final-state wave function are obtained with several approximations of the optical potential; (i) omission of the optical potential, (ii) inclusion of the lowest term and dominant pole term, and (iii) a closure approximation which depends on an effective energy $\bar{\mathcal{E}}_N$ for each threshold energy E_N. The threshold law in all these cases is obtained. In the closure approximation the law depends on the sign and N dependence of $E_N-\bar{\mathcal{E}}_N$. However, the above phenomenon of eigenvalues descending below threshold suggests that $E_N-\bar{\mathcal{E}}_N$ is an oscillating function of N. In that case the derivative of the yield curve is an oscillating (but non-negative) function of the available energy E. A form of such a threshold law is given. (auth)

4457 MULTIPHOTON EXCITATION AND IONIZATION OF He ATOMS IN AN INTENSE LASER BEAM. Mohan, M.; Haque, S.N. (Department of Physics and Astrophysics, University of Delhi, Delhi-7, India). Phys. Rev. A 9: No. 2, 725-731 (Feb 1974).

Transition amplitudes corresponding to bound-bound and bound-free multiphoton transitions for an He atom in the presence of an intense laser beam have been evaluated. Results show that for multiphoton excitation the transition amplitude for small values of N (the number of photons being absorbed) decreases with increasing intensity. However, for higher values of N the amplitude continues to rise with increasing intensity. A particular feature of the present method of calculating multiphoton ionization is that the transition amplitude increases linearly for small values of the intensity, but for higher values, the slope of the curve decreases, showing an important nonlinear effect. (auth)

4458 COINCIDENCE MEASUREMENT OF THE FULLY DIFFERENTIAL CROSS SECTION FOR ATOMIC-FIELD BREMSSTRAHLUNG. Faulk, J.D.; Quarles, C.A. (Department of Physics, Texas Christian University, Fort Worth, Texas 76129). Phys. Rev. A 9: No. 2, 732-742 (Feb 1974).

A coincidence measurement of the absolute cross section for electron-atomic-field bremsstrahlung, differential in photon energy, photon emission angle, and electron-scattering angle, is reported. The incident electron energy was 140 keV and the scattering materials were thin films of aluminum and gold. Measurements were made for the following cases of electron-scattering angle (θ_{e1}), photon-emission angle ($\theta_{\gamma 1}$), and photon energy (k): $\theta_{e1}=15°$, $\theta_{\gamma 1}=270°$, and k=30 and 70 keV; $\theta_{e1}=30°$, $\theta_{\gamma 1}=270°$, and k=20 and 70 keV; and $\theta_{e1}=30°$, $\theta_{\gamma 1}=30°$, and k=20, 30, 50, and 70 keV. The data are compared to the theoretical calculations of Elwert and Haug and Bethe and Heitler. Both theories give generally satisfactory agreement for aluminum. The Elwert-Haug theory is somewhat more accurate for gold, although neither theory agrees with the data at $\theta_{\gamma 1}=270°$ and k=70 keV. A discrepancy between theory and experiment for both gold and aluminum also appears to exist for low photon energies (k=20 keV) for the case of both the electron and photon being emitted at 30°. (auth)

4459 EIKONAL APPROXIMATION APPLIED TO ATOM-ATOM EXCITATION AT INTERMEDIATE ENERGIES: EXCITATION OF H BY H. Shields, R.H.; Peacher, J.L. (Physics Department, University of Missouri-Rolla, Rolla, Missouri 65401). Phys. Rev. A 9: No. 2, 743-751 (Feb 1974).

The eikonal distorted-wave Born approximation (DWBA) developed recently by Chen, Joachain, and Watson is applied to atom-atom excitation in the intermediate energy range. In this paper the excitation of a hydrogen atom to the 2s,2$p_\pm$ or 2p_0 state by hydrogen impact is considered. Differential cross sections are presented. Total cross sections are presented and compared to previous calculations. It is shown that the eikonal DWBA results for the total cross section approach the two-state distortion-approximation results in the limit of high energy and very-small-angle scattering. (auth)

4460 POLARIZATION CORRELATIONS IN ATOMIC-FIELD PAIR PRODUCTION. Tseng, H.K.; Pratt, R.H. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. A 9: No. 2, 752-761 (Feb 1974).

Atomic-field pair-production polarization correlations between incident photon and emitted positron are discussed for incident photon energies in the range 1.073-2.615 MeV. Results are reported from an exact numerical calculation in partial-wave formulation using screened potentials. It is shown that pair production can be used as a polarizer of positrons, or transmitter of polarization from photons to positrons, or an analyzer of polarized photons. In heavy elements at suitable positron angles, all these correlations can be large. It is shown that the polarization correlations are practically independent of atomic-electron screening, which is a consequence of the normalization screening theory discussed in our previous work. (auth)

4461 TITANIUM AND COPPER K X-RAYS PRODUCED BY COLLISIONS WITH FISSION FRAGMENTS FROM ^{252}Cf. Budick, B.; Rushton, A.M. (Physics Department, New York University, New York, New York 10003). Phys. Rev. A 9: No. 2, 762-767 (Feb 1974).

We have observed the energy shifts and intensity ratios of the K x rays of titanium and copper excited by bombarding foils of these materials with fission fragments from the spontaneous fission of ^{252}Cf. A lithium-drifted-silicon detector was employed to make the measurements. For both metals studied, larger shifts in the x-ray energies were observed than were recorded for nickel by Watson and Li in their investigation using only the light fission fragments as projectiles. In addition, the $K\beta/K\alpha$ intensity ratio for titanium, after correcting for K-edge absorption in the foil, was found to be very small. We interpret this last result as being due to very high stripping of the M shell of the recoiling titanium atom in collisions with other titanium atoms. (auth)

4462 VACUUM-ULTRAVIOLET EMISSION FROM HIGH-PRESSURE XENON AND ARGON EXCITED BY HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS. Koehler, H.A.; Ferderber, L.J.; Redhead, D.L.; Ebert, P.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. A 9: No. 2, 768-781 (Feb 1974).

High-pressure Xe and Ar were excited by high-current relativistic-electron bursts. The spectral and temporal characteristics of the uv continua, centered near 1700 Å in Xe and 1260 Å in Ar, were measured. The maximum of the Xe spectral distribution shifted from 1690 ± 9 to 1710 ± 9 Å, and the spectral width decreased from 150 ± 3 to 110 ± 3 Å when the pressure was raised from 2 to 34 atm. The shift of the Ar continuum centered at 1260 ± 9 Å was negligible and the spectral width decreased from 130 ± 3 to 90 ± 3 Å when the pressure was raised from 2 to 61 atm. Exponential time constants for the buildup and decay of the Xe and Ar continua were obtained. They are characterized by a $P^{-1.5}$ pressure dependence below 3 atm. Pressure-independent decay time constants of 4 ± 1, 16 ± 2.5, and about 280 nsec were obtained for Xe at high pressure. For Ar the pressure-independent decay time constants were 6 ± 1.5, 30 ± 5, and about 230 nsec. The efficiency for conversion of electron kinetic energy to uv energy was 10 ± 4% in Xe and 15 ± 7% in Ar. (auth)

4463 PROJECTILE CHARGE STATE DEPENDENCE OF K X-RAY PRODUCTION BY 1-4-MeV/amu HEAVY IONS IN GASES. Mowat, J.R.; Sellin, I.A.; Griffin, P.M.; Pegg, D.J.; Peterson, R.S. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. A 9: No. 2, 644-651 (Feb 1974).

We report the observation of large projectile-structure effects in heavy-ion-induced K x-ray yields from thin, light gas targets in a projectile energy region (~ 1-4 MeV/amu) where molecular promotion effects are not expected to be significant. The K x-ray yield from both projectile and target is found to be very sensitive to the ionic charge q of the projectile. In some cases, notably for Ar^{q+} on Ne at 80 MeV and for Cl^{q+} on Ne at 42 MeV, the target yield increases exponentially with projectile charge, the projectile nuclear charge and velocity remaining constant. In all cases, the projectile K x-ray yield increases faster than exponentially, even when the incident projectile has a full K shell. It is evident that targets become highly ionized in these collisions, and already highly ionized projectiles are often further ionized in these targets of less-than-equilibrium thickness. We discuss the limitations imposed on the determination of absolute x-ray cross sections in multiply ionizing collisions. These limitations cast serious doubt on the accuracy of K-shell ionization cross sections extracted from measured K x-ray cross sections in this and other experiments. The projectile-target combinations studied in the present experiment are Ar^{q+} on Ne (at 80 and 152 MeV), Cl^{q+} on Ne and SF_6 (at 42 and 50 MeV), and F^{q+} on two chlorine-bearing Freon compounds (at 43 MeV). (auth)

4464 Pb AND Bi L-SUBSHELL IONIZATION CROSS-SECTION RATIOS VERSUS PROTON BOMBARDING ENERGY FROM 0.5 TO 4 MeV. Madison, D. H. (University of North Carolina, Chapel Hill, North Carolina 27514); Baskin, A. B.; Busch, C. E.; Shafroth, S. M. Phys. Rev. A 9: No. 2, 675-681 (Feb 1974).

Experimental ratios of L-subshell cross sections are given for ionization of lead and bismuth by 0.5-4-MeV-proton bombardment. The ratio of the L_{II} to L_I cross sections exhibits a maximum near 1.75 MeV. Individual subshell cross sections are obtained from the experimental ratios and previous total-cross-section data. These subshell ratios and cross sections are compared with the theoretical predictions of the plane-wave Born approximation using nonrelativistic hydrogenic wave functions, of the binary-encounter approximation scaled from Mg K-shell cross sections, and of the binary-encounter approximation scaled from cross sections obtained using L-shell velocity distributions. It was found that both approximations predict the trend of the data for the L_{II} and L_{III} subshells, but that only the plane-wave Born approximation gave the proper behavior for the L_I subshell. (auth)

4465 SIMPLE MODEL FOR K X-RAY AND AUGER-ELECTRON ENERGY SHIFTS IN HEAVY-ION COLLISIONS. Burch, D.; Wilets, L. (Department of Physics,

University of Washington, Seattle, Washington 98195); Meyerhof, W.E. Phys. Rev. A 9: No. 2, 1007-1010 (Feb 1974).

K x-ray and Auger-electron energies in heavy-ion collisions are shifted in energy in an opposite manner as the degree of ionization in the L shell increases. X rays are shifted to higher energies and Auger electrons to lower energies. We describe a very simple model which accounts for these effects and provide crude estimates of the shifts. (auth)

4466 AUTODETACHING STATE OF F^- AND AUTOIONIZING STATES OF F. Edwards, A.K.; Cunningham, D.L. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. A 9: No. 2, 1011-1012 (Feb 1974).

The collisional excitation method is used to excite an autodetaching state of F^- and several autoionizing states of neutral F. The F^- state lies at 14.85 $\pm$ 0.04 eV above the neutral-fluorine ground state and has as its dominant configuration $2p^4(^1D)3s^2\ ^1D$. The observed autoionizing states of fluorine have configurations $(^1D)nl^-$ and $(^1S)nl^-$. (auth)

4467 ELECTRON CAPTURE FROM He($1s^2$) BY PROTONS. III. Mapleton, R.A. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730); Doherty, R.W.; Meehan, P.E. Phys. Rev. A 9: No. 2, 1013-1016 (Feb 1974).

The prior (i), post (f), and distorted wave (dw) forms of the first Born approximation, and a one-parameter approximate helium wave function, are used to calculate cross sections for electron capture from He($1s^2$) by protons. These cross sections are calculated for capture into H(3 lm), $l = 1, 2$; $-l \leq m \leq l$, for impact energies, $10 \leq E \leq 1000$ keV, leaving the residual ion $He^+(1s)$. The associated polarizations P are calculated for the axis of quantization of H parallel to the direction of incidence, and the apparent cross sections $Q_A = 3Q(3 - P)^{-1}$ are obtained from P and the calculated cross sections $Q = \Sigma'_{m=-l}Q_m$. The Q used to determine Q_A are Q(dw) and the arithmetic average of Q(i) and Q(f). Of these two sets, Q_A(dw) predicts the measured Q_A(3p) more successfully for $E < 250$ keV, and the measured Q_A(3d) better for $E < 200$ keV. For larger values of E both sets predict the measured values equally well. In the range $15 \leq E \leq 60$ keV, the effect of P(dw) is more marked for capture into H(3p) than into H(3d). (auth)

4468 NONADIABATIC MOLECULAR COLLISIONS: CHARGE EXCHANGE AND CHEMICAL REACTION IN THE $Ar^+ + H_2$ SYSTEM. Chapman, S.; Preston, R.K. (Department of Chemistry, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 60: No. 2, 650-659 (15 Jan 1974).

The three adiabatic surfaces needed to describe $Ar^+ + H_2$ in the nonrelativistic limit are calculated using the diatomics-in-molecules with zero overlap approach. Approximate nonadiabatic interaction terms which couple these surfaces are computed. Using these terms, a first-order semiclassical calculation of the electronic transition probabilities is carried out. The results imply that all the important nonadiabatic transitions are localized in the reactant channel around an avoided crossing between the surfaces formed from combination of $Ar(^1S) + H_2^+(^2\Sigma_g)$ and of $Ar^+(^2P) + H_2(^1\Sigma)$. Because the results show that the transitions are induced by vibrational motion of the diatomic, any realistic study of the dynamics must include the full three dimensionality of the problem. We investigated the dynamics using the 3D trajectory surface hopping model proposed by Tully and Preston. $Ar^+ + H_2(v = 0)$ was studied at a relative energy of 3.36 eV. The predictions of the model for cross sections, average final translational energy, and average scattering angle agree well with experiment for both charge exchange and molecular rearrangement products. A discussion of the conceptual picture which emerges from this model is given. (auth)

4469 OBSERVATION OF TWO-ELECTRON PENNING IONIZATION IN A THERMAL-ENERGY COLLISION. Arrathoon, R.; Littlewood, I.M.; Webb, C.E. (Clarendon Laboratory, Oxford, England). Phys. Rev. Lett. 31: No. 19, 1168-1170 (5 Nov 1973).

The existence of the hybrid Penning reaction, $He^+ + X \rightarrow He + X^{++} + e$, has been confirmed for thermal-energy collisions of He^+ with Mg, Ca, Sr, Ba, Y, Ce, Yb, Sn, and Pb. A new two-electron Penning reaction, $He^* + X \rightarrow He + X^{++} + 2e$, has been identified in He^*-Ce and He^*-Y collisions. (auth)

4470 STRUCTURES IN ELECTRON-IMPACT EXCITATION CROSS SECTIONS OF He FROM 30 TO 70 eV. Ormonde, S. (Quantum System, Inc., Albuquerque, New Mexico 87108); Golden, D.E. Phys. Rev. Lett. 31: No. 19, 1161-1164 (5 Nov 1973).

Close-coupling calculations of e-He scattering in the region 30-70 eV reveal structures in the $n=2\ ^1S$ excitation cross sections between 30 and 50 eV, in agreement with recent experiments. The structures are attributed to open-channel compound-state formation. Additional structures are also predicted at both higher and lower energies. These calculations suggest that temporary negative-ion formation should be considered as a mechanism for triplet excitation. (auth)

4471 HIGH-RESOLUTION K-AUGER SPECTRA FOR MULTIPLY IONIZED NEON. Matthews, D.L.; Johnson, B.M.; Mackey, J.J.; Moore, C.F. (Center for Nuclear Studies, University of Texas at Austin, Austin, Texas 78712). Phys. Rev. Lett. 31: No. 22, 1331-1334 (26 Nov 1973).

K-Auger transitions of neon produced by 33-MeV O^{5+} bombardment are clearly resolved above a broad peaked background. Besides the 5 normal transitions, we observe 58 satellite lines stemming from initial configurations having single K-shell, multiple L-shell vacancies. Transition energies and relative intensities are measured and compared with those obtained with 1.5-keV electron bombardment. Calculated energies for Auger satellite transitions are used to give possible identifications for observed lines. (auth)

4472 K-VACANCY SHARING IN NEAR-SYMMETRIC HEAVY-ION COLLISIONS. Meyerhof, W.E. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 31: No. 22, 1341-1344 (26 Nov 1973).

Relative production cross sections for beam (Z_1) and target (Z_2) K vacancies in heavy-ion collisions are explained for situations where $Z_1 \simeq Z_2$. Electron promotion creates a vacancy in the $2p\delta$ molecular orbital. As the collision partners retreat, the vacancy has a probability $\omega(v_1, Z_1, Z_2) \leq 1/2$ to be transferred to the 1s level of the higher-Z collision partner. With a charge-transfer theory of Demkov, a universal form for ω is obtained, which is in excellent agreement with all available data for Ni, Br, and I beams over extended target and energy ranges. (auth)

4473 NONMONOTONIC TARGET DEPENDENCE OF Cl K X-RAY-PRODUCTION CROSS SECTIONS IN SINGLE HEAVY-ION-ATOM COLLISIONS. Winters, L.; Macdonald, J.R.; Brown, M.D.; Chiao, T.; Ellsworth, L.D.; Pettus, E.W. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. Lett. 31: No. 22, 1344-1347 (26 Nov 1973).

Chlorine K x-ray-production cross sections have been measured in single collisions of chlorine ions in low incident charge states with gas targets at MeV energies. The cross sections are nonmonotonic as a function of target atomic number, but they approach monotonicity with increasing projectile energy. To explain these results in terms of $2p\delta$-$2p\pi$ transitions in nearly symmetric collisions effectively requires 2p vacancy production simultaneous with the promotion of Cl 1s electrons. (auth)

4474 ION-ELECTRON COINCIDENCE MEASUREMENTS IN SLOW HEAVY-PARTICLE COLLISIONS. Gerber, G.; Niehaus, A. (Fakultät für Physik der Universität Freiburg, 78 Freiburg, West Germany). Phys. Rev. Lett. 31: No. 20, 1231-1234 (12 Nov 1973).

Ions scattered inelastically off neutral target atoms at low collision energies ($\lesssim 10$ keV) are measured in delayed coincidence with electrons formed in the collision. Both ions and electrons are analyzed differentially with respect to angle and energy. In the case of the He^+/Ne system at 1-keV collision energy, it is shown that the coincidence measurements allow an unambiguous identification of the main ionization processes occurring. (auth)

4475 ROLE OF ELECTRON DEEXCITATION IN POPULATING CADMIUM AND ZINC IONIC LEVELS. Latush, E.L.; Mikhalevskii, V.S.; Sem, M.F. Opt. Spectrosc. (USSR) 34: No. 2, 120-123 (Feb 1973).

The mechanism of populating cadmium and zinc ionic levels during a discharge in mixtures with helium has been investigated. It is shown that the populations of the levels in the one-electron spectrum of Cd II and Zn II which lie below the He^+ level are determined not only by charge transfer and by the subsequent radiational dissociation, but also by electronic deexcitation. (auth)

4476 DETERMINATION OF SHORT-RANGE ATOM-ATOM POTENTIALS IN HIGH ENERGY COLLISIONS OF He, N, AND CH_4 ON CH_4. Leonas, V. B.; Sermyagin, A. V. (Space Research Inst., Moscow). Chem. Phys. (Amsterdam); 2: No. 4, 462-466 (Dec 1973).

The method and results of direct determination of the anisotropic short-range interaction of additive type for the He, N, CH_4-CH_4 systems are given. Fast beam scattering (integral and differential) was studied, and this made it possible to obtain the data on interaction potentials in the range from 0.1 to 10 eV. (auth)

4477 RATE OF ENDOTHERMIC ION-MOLECULE REACTIONS OF SYMMETRIC CHARGE TRANSFER SYSTEMS IN NON-THERMAL ELECTRIC FIELDS. Rebentrost, F. (Technische Un'v. Munich). Chem. Phys. (Amsterdam); 2: No. 3, 253-261 (Nov 1973).

The bimolecular rate constant for endothermic reactions of symmetric charge transfer systems in intermediate and strong elastic fields may be written as $k = k_0(T_i) \exp[-E_0/k_B T_i]$. Expressions for $k_0(T_i)$ are given and compared with thermal frequency factors. T_i is determined by a suitably defined effective cross section in the Boltzmann equation as $T_i = \frac{1}{2}(T_g + eK/k_B \sigma_{eff} N)$. An analysis of σ_{eff} and its connection to other types of

cross sections is made for symmetric charge transfer and for the general case of $m \neq M$. (auth)

4478 ELECTRON IMPACT IONIZATION OF LONG-LIVED EXCITED HELIUM ATOMS. Shearer-Izumi, W.; Botter, R. (Centre Hospitalier Regional, Bretonneau, France). J. Phys., B (London); 7: No. 4, L125-L128(11 Mar 1974).

Relative electron impact ionization cross sections for the metastable 2^3S and 2^1S states and for the highly excited, long lived states of helium were obtained using a double electron beam technique. (auth)

4479 SCATTERING OF SLOW IONS BY THE SURFACE OF SOLIDS. Veksler, V. I.; Evstifeev, V. V. (Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2570-2572 (Dec 1973). (In Russian).

Within the framework of the Born-Meyer potential with use of the Silsbee approximation a theoretical evaluation is made of the applicability of the model of paired successive ion collisions with two atoms of a lattice in the low energy region (less than 600 to 800 eV) of primary Cs^+ ions during their scattering by the atoms of W monocrystals. (tr-auth)

4480 BLOCKING EFFECTS DURING THE SCATTERING OF MEDIUM-ENERGY IONS BY CRYSTALS. Mashkova, E. S.; Molchanov, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2568-2569(Dec 1973). (In Russian).

The influence of the blocking effect on the character of the energy distribution of ions scattered by the (110) face of Cu is studied using Ar ions at energies from 10 to 30 keV. It is shown that with decrease of either the angle of emergence or the slipping angle a very sharp decrease of the form of the energy distribution occurs within a narrow angular interval. This reduces to a nonmonotone dependence of the relative intensity of the double peaks on the scattering angle at a fixed slipping angle. (JSR)

4481 CALCULATION OF THE KINETIC ELECTRON EMISSION DURING IRRADIATION OF FINE FOILS WITH MULTICHARGED IONS AT AN ENERGY OF 0.1 TO 2 MeV/NUCLEON. Parilis, E. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2565-2567(Dec 1973). (In Russian).

A calculation was made of the coefficients of kinetic energy emission with the front and back sides of fine metallic foils (0.1 to 1 mg/cm) during their irradiation with multicharged ions of Xe and Ar at an energy of 0.1 to 2 MeV/nucleon. (tr-auth)

4482 SPATIAL ANGULAR AND ENERGY DISTRIBUTION OF IONS SCATTERED BY MONOCRYSTALS. Mukhamedov, A.; Parilis, E. S.; Turaev, N. Yu.; Umarov, F. F. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2562-2564(Dec 1973). (In Russian).

Simulation on the M-32 computer of the scattering of 30-keV argon ions on two adjacent atoms of Cu shows that the relation of the single and double scattering is substantially different from the analytical evaluation and close to the experimental observations. (tr-auth)

4483 DIRECT SIMULATION OF INELASTIC SCATTERING OF ELECTRONS. Characteristics of the Angular Distribution. Golovyashkina, L. V.; Kosarev, Yu. G.; Nakhodkin, N. G. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2480-2487(Dec 1973). (In Russian).

The results of the investigation of the differential characteristic of the inelastic scattering medium energy electrons (500 E_0 40,000 eV), obtained by the direct computer simulation with broad use of tabulated methods of calculation, are reported. The results obtained agree well with experimental data for reflected medium energy electrons. (tr-auth)

4484 ROTATIONAL TRANSITIONS IN H_2 BY Li^+ COLLISIONS AT $E_{c.m.} = 0.6$ eV: COMPARISON WITH EXPERIMENT. Lester, W. A. Jr.; Schaefer, J. (IBM Research Laboratory, San Jose, California 95193). J. Chem. Phys.; 60: No. 4, 1672-1674 (15 Feb 1974).

Differential cross sections were calculated by using self-consistent-field (SCF) and configuration-interaction(CI) potential energy surfaces and compared with experimental data in terms of cross section ratios. The theoretical cross sections are in good agreement for inelastic transitions, whereas the elastic cross sections display somewhat larger differences. The latter can be related to features of the spherical part of the potential energy surfaces. It is concluded that the SCF and CI hypersurfaces provide comparable descriptions of the forces operative during the collision. (1 table) (RWR)

4485 REACTIVE SCATTERING OF HYDROGEN AND DEUTERIUM ATOMS FROM HALOGEN MOLECULES. Grosser, J.; Haberland, H. (Univ. Freiburg i. B.). Chem. Phys. (Amsterdam); 2: No. 3, 342-351(Nov 1973).

Angular distributions of H and D atoms reactively scattered from the halogen molecules Cl_2, Br_2, I_2, ICl, IBr were measured. The angular distributions are backwards or sideways peaked. No isotope effect on the angular distribution was found. The total reactive cross sections are 1-10 Å^2, and for D atoms they are about 50% larger than for H atoms. A simple direct interaction model is proposed, which shows good agreement with the experimental results. (auth)

4486 CORE-EXCITED RESONANCES IN HYDROGEN. Spence, D. (Argonne National Lab., IL). J. Phys., B (London); 7: No. 4, L87-L90(11 Mar 1974).

Using an electron transmission spectrometer additional core-excited resonances are located in the total cross section for scattering of electrons by molecular hydrogen in the energy range 11.0 to 13.0 eV. The energies of these additional resonances are in good agreement with those recently measured by Joyez et al (J. Phys. B., Atom. Molec. Phys.; 6: 2427-40 (1973)) in an inelastic channel. (auth)

4487 $\Sigma^+ \rightarrow \Sigma^-$ ($\Sigma^- \rightarrow \Sigma^+$) TRANSITIONS IN ATOM-DIATOM COLLISIONS. Durup, J. (Paris Univ., Orsay, France). Chem. Phys. (Amsterdam); 2: No. 2, 226-232(Oct 1973).

The differential cross section for $\Sigma^+ \rightarrow \Sigma^-$ or $S_g \rightarrow S_u$ transitions in atom-diatom collisions is shown to be zero at zero scattering angle, to increase as $\sin^2 \theta$ at small scattering angle θ, and to reach usually a single maximum at small θ; whatever be θ, the cross section is zero in first Born approximation if no charge exchange occurs. Factors favoring such transitions are the presence of potential surface crossings at small atom-diatom distances, and the occurrence of charge exchange. The discussion is readily extended to the case of heavy nuclei with large spin-orbit coupling. The conclusions are compared with the experimental evidence. (auth)

4488 DISSOCIATION OF HYDROGEN MOLECULES IN COLLISIONS WITH LIGHT ALKALI IONS. I. Na^+-D_2. Schoettler, J.; Toennies, J. P. (Max-Planck-Institut fuer Stroenmungsforschung, Goettingen, Ger.). Chem. Phys. (Amsterdam); 2: No. 2, 137-157(Oct 1973).

The dissociation of a ground state D_2 molecule in single collisions with a Na^+ ion was studied using a time of flight technique over a large range of scattering angles and collision energies ($10 < E_{cm} < 40$ eV). A trial and error method, which takes account of all sources of experimental smearing was used to obtain center of mass inelastic differential cross sections (contour maps). These results indicate that the dissociation proceeds by a two-step mechanism. The first step is a two-body activation collision, which is observed directly in the experiment. (auth)

4489 MEASUREMENTS OF THE ENERGY DISTRIBUTION OF BACKSCATTERED KILOVOLT ELECTRONS WITH A SPHERICAL RETARDING-FIELD ENERGY ANALYZER. Matsukawa, T.; Shimizu, R.; Hashimoto, H. (Osaka Univ.). J. Phys., D (London); 7: No. 5, 695-702(21 Mar 1974).

A spherical retarding-field electron energy analyzer was constructed to investigate the backscattering and transmission of electrons in the energy range 10 to 30 keV. It consists of full-spherical meshes with collector, and attains a resolution of about 2%. By using this apparatus, the energy distribution of electrons backscattered from C, Al, Cu, Au and Cu-Au alloy specimens is obtained. Results are compared with those obtained from Monte Carlo calculations. (auth)

4490 EMPIRICAL TREATMENT OF FAST-ELECTRON SCATTERING IN SEMI-INFINITE TARGETS. Lantto, V. (Univ. of Oulu, Finland). J. Phys., D (London); 7: No. 5, 703-712(21 Mar 1974).

A simple empirical treatment is given of the absorption of fast electrons and their energy at normal incidence in semi-infinite targets. It is based on the consideration of the multiple reflection of electrons at imaginary planes parallel to the surface. Experimental data measured on films of various thicknesses for transmitted and backscattered electrons can be used for calculations for semi-infinite targets. Analytical expressions are also set up to describe the behavior of electrons transmitted through or backscattered from a film. From these it is possible to analyze the multiple reflection of 10 to 100 keV electrons for nearly all elements. As an application, the energy dissipation is calculated for 20 keV electrons in copper and gold, and the results are compared with those of other investigators. The present values resemble those calculated by Spencer (NBS Monograph No. 1 (Washington DC: USA GPO) (1959)) and by Bishop (Br. J. Appl. Phys.; 18: 703-15(1967)). (auth)

4491 EVALUATION OF ATOMIC SCATTERING INTEGRALS BY NUMERICAL TECHNIQUES. Miller, K. J. (Rensselaer Polytechnic Inst., Troy, NY). J. Comput. Phys.; 14: No. 3, 269-285(Mar 1974).

Integrals needed in calculations of electron scattering of atoms are solved. The basis functions consist of Slater-type functions to describe the bound-like character of the wave function, and spherical Bessel functions of the first and second kind for the free particle portion. A damping factor is used with the latter Bessel function to insure proper behavior at the origin. With integral representations of the Bessel functions, numerical techniques are developed to obtain all one- and two-electron integrals. (auth)

4492 ARGON L-SHELL AUGER SPECTRA PRODUCED IN Ar^+–Ar COLLISIONS. Stolterfoht, N.; Schneider, D.; Gabler, H. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Phys. Lett.; 47A: No. 4, 271-272(8 Apr 1974).

Argon L-shell Auger spectra were measured by 100 to 550 keV Ar^+ impact on Ar. Observed line structure in the spectra are interpreted both by multiple outer-shell ionization and Doppler effects. (auth)

4493 ISOTOPE SHIFT AND HYPERFINE STRUCTURE IN THE 2537 A LINE OF Hg BY LINE-CROSSING EXPERIMENTS IN FORWARD SCATTERING. Stanzel, G. (Physics Inst., Giessen, Ger.). Phys. Lett.; 47A: No. 4, 283-284(8 Apr 1974).

The line-crossing effect between Zeeman components of different isotopes was studied experimentally and theoretically in forward-scattered light in order to determine the isotope shift and hyperfine structure. The influence of the spectral distribution of the incident radiation was properly considered. (auth)

4494 ATOMIC ASPECTS. pp 701-707 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Seven papers on this topic are presented. The subjects include the following: dynamical effects in the autoionization of positrons in heavy-ion collisions; nuclear excitation by electron transition and its application to ^{235}U separation; the two-center Dirac equation and its applications in heavy-ion physics; K x-ray excitation of solid targets with 150-MeV Xe ions; observation of Z = 70 K x-rays in Br + Br collisions; ionization following α bombardment; and heavy-ion-induced radiative capture and bremsstrahlung from bound electrons. (RWR)

4495 COMMENTS ON Ar L-SHELL FLUORESCENCE YIELDS IN Ar^+–Ar COLLISIONS. Saris, F. W.; Bhalla, C. P. (Massachusetts Inst. of Tech., Cambridge). J. Phys., B (London); 7: No. 4, L115-L117(11 Mar 1974).

Significant discrepancies between Ar L-shell fluorescence yields as determined from total cross sections and from spectral measurements in Ar–Ar collisions are shown not to be due to an error in the measured x-ray cross sections, as was suggested by Fortner and Garcia (J. Phys. B. Atom. Molec. Phys.; 6: L346-348 (1973)). Discrepancies originate from ambiguities in identifying the atomic states involved in their spectral method. (auth)

4496 CROSS SECTIONS FOR THE Ar–L X RAY EMISSION IN COLLISIONS OF He^+, Ne^+, AND Ar^+ IONS WITH Ar ATOMS. Schartner, K. R.; Schaefer, R.; Rippler, R. (Univ., Giessen, Ger.). J. Phys., B (London); 7: No. 4, L111-L114(11 Mar 1974).

Ar–L x ray production cross sections for collisions of He^+, Ne^+, and Ar^+ ions of energies between 100 keV and 1 MeV with Ar atoms were measured. The results are in good agreement with comparable cross section data. (auth)

4497 EFFECTIVE CROSS SECTION FOR IONIZATION BY ELECTRONS OF MOLECULES IN HYDROGEN CLUSTERS. Henkes, W.; Mikosch, F. (Kernforschungszentrums, Karlsruhe, Ger.). J. Mass Spectrom. Ion Phys.; 13: No. 2, 151-161(Feb 1974).

The effective cross section, σ_{eff}, for ionization by electrons of molecules in hydrogen cluster beams is measured in the energy range from 30 to 500 eV. The mean cluster size is varied from $\bar{N} \approx 340$ up to $\bar{N} = 85{,}000$ molecules per cluster. For $\bar{N} \geq 8{,}000$ the energy dependence of σ_{eff} shows two humps at ≈180 and ≈260 eV respectively which were not observed in previous measurements of the ionization cross section of clusters. The result is explained in terms of a simple model developed previously. From the dependence of the ionization cross section of clusters on their size it is concluded that the average escape depth of secondary electrons is 5.5 molecular diameter. (auth)

4498 SECONDARY-ION EMISSION DURING BOMBARDMENT OF COPPER AND ALUMINIUM SINGLE CRYSTALS WITH ALKALI IONS. Kerkow, H.; Trapp, M. (Humboldt-Univ., Berlin). J. Mass Spectrom. Ion Phys.; 13: No. 2, 113-122(Feb 1974).

Energy and angular distributions of secondary ions emitted during alkali ion bombardment of aluminium and copper single crystals were measured. For the angular distributions preferred directions were obtained, which can be correlated with low-indexed crystal orientations. For these orientations noticeable variations in the energy spectrum of the secondary ions were found for aluminium also. The results can be satisfactorily interpreted on the basis of the model of focusing collision sequences. (auth)

4499 KINETIC ION–ELECTRON EMISSION FROM SEMICONDUCTOR SURFACES FROM BOMBARDMENT WITH POSITIVE RARE GAS IONS IN THE ENERGY REGION 2 TO 25 keV. Gaworzewski, P.; Krebs, K. H.; Mai, M. (Humboldt-Univ., Berlin). J. Mass Spectrom. Ion Phys.; 13: No. 2, 99-112(Feb 1974). (In German).

Electron yields are measured when atomically clean (111) surfaces of Ge, GaAs and GaP are bombarded with Ne^+, Ar^+ and Kr^+ ions in the energy range 2 to 25 keV. Energy distributions of the released electrons from these materials and Si are received. The electron yields have a similar magnitude like metals and increase nonlinearly with increasing ion energy. The shape of the energy distributions is essentially influenced by the species of target material. By means of a model conception it is discussed that the dependence on Z_1 of the electron emission is effected by the structure of the electronic shell of the bombarding ions and also the dependence on Z_2 is effected by the electronic and crystallic structure of the target material. (auth)

4500 TRIPLE CENTRE APPROXIMATION FOR CHARGE EXCHANGE IN ATOMIC SCATTERING THEORY. Anderson, D. G. M.; Antal, N. J.; McElroy, M. B. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 7: No. 4, L118-L121(11 Mar 1974).

A triple center approximation is proposed to describe proton-hydrogen charge changing collisions. Favorable agreement with experiment encourages further research into the applicability of three center expansions. (auth)

4501 CONVERSION OF PHENOMENOLOGICAL CROSS SECTIONS FOR ION–MOLECULE REACTIONS. Reuben, B. G. (Hebrew Univ., Jerusalem). J. Mass Spectrom. Ion Phys.; 13: No. 2, 181-183(Feb 1974).

A calculation of the cross sections for ion–molecule collisions using Light's equation shows that ions have the greatest reaction cross section when they have thermal energies before they are accelerated. Also it is found that ions initially moving away from the slit and whose direction is reversed by the repeller must have a particularly high cross section at the moment when their direction of travel is reversed. (JFP)

Atomic Theory

Refer also to abstracts 4119 and 5356.

4502 NUCLEAR MASS DEPENDENCE OF THE CIRAC–BREIT–PAULI HAMILTONIAN. Karwowski, J.; Fraga, S. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 6, 536-540(15 Mar 1974).

The nuclear mass dependent (relativistic, specific, and normal) corrections for many electron atoms are discussed. Numerical values, determined from Hartree-Fock functions for all the neutral atoms from helium through nobelium, show that the relativistic mass correction, never included in actual calculations, is of the same order of magnitude as the specific mass effect. (auth)

4503 SIMILARITY SOLUTION OF THE THOMAS–FERMI EQUATION FOR DIATOMIC HOMONUCLEAR MOLECULES. Dmitrieva, I. K.; Shadyro, O. L. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 18: No. 3, 207-209(Mar 1974). (In Russian).

The utility of the quantum-statistical Thomas-Fermi model for a description of homonuclear diatomic molecules is studied. Within the framework of this model the similarity equation was derived and solved numerically by the Runge-Kutta method. (tr-auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

4504 MHD SWITCH-ON SHOCK STRUCTURE. Bighel, L.; Collins, A. R.; Cross, R. C. (Univ. of Sydney). Phys. Lett., A; 47A: No. 4, 333-334(8 Apr 1974).

An experimental study of the structure of an MHD switch-on shock propagating into an almost fully ionized helium plasma is described. It is found that electrons are heated in preference to ions. (auth)

4505 EXISTENCE OF A NEW TYPE OF EQUILIBRIUM ROTATING ELLIPSOID IN THE PRESENCE OF A TOROIDAL MAGNETIC FIELD. Oganesyan, R. S. (Erevan State Univ.). Dokl. Akad. Nauk Arm. SSR; 55: No. 3, 167-170(1972). (In Russian).

The possibility of the existence of a rotating equilibrium figure of a self-gravitating conducting fluid mass in the presence of an external toroidal magnetic field is examined. (JSR)

4506 NONSTATIONARY PLASMA FLOW IN A COAXIAL CHANNEL. Belan, N. V.; Zabara, S. I.; Mashtylev, N. A. Samoletostr. Tekh. Vozdush. Flota; No. 32, 50-57(1973). (In Russian).

A higher-speed plasma wave, with a maximum near the central electrode, is shown to be moving in a plasma intermittently accelerated by electric pulses in a channel formed by two coaxial cylindrical electrodes. The magnetic field increased over the length of the channel but began weakening after a certain moment of time, with the plasma flow becoming steady when the constant in an expression describing this plasma flow assumes a value of 2.4. (IAA)

4507 NORMAL MODES OF LINEARIZED MAGNETOHYDRODYNAMICS. Corkum, P. B. (Lehigh Univ., Bethlehem, PA). Can. J. Phys.; 52: No. 6, 509-515(15 Mar 1974).

A general set of magnetohydrodynamic equations is derived for a two component plasma in an external magnetic field and the eigenmodes of the linearized equations are found. The magnetohydrodynamic equations are derived from nonequilibrium thermodynamic principles. It is pointed out that a minimal set of phenomenological coefficients are found in this manner. The magnetohydrodynamic equations are linearized and then solved for the magnetohydrodynamic equations are linearized and then solved for the magnetohydrodynamic eigenmodes in the two special cases of the wave vector k parallel and perpendicular to the external magnetic field. (auth)

4508 DETERMINATION OF THE LAMINAR VELOCITY AND TEMPERATURE PROFILES IN THE THERMAL ENTRANCE REGION OF A MHD CHANNEL BY MEANS OF KANTOROWITSCH METHOD. Javeri, V. Berlin; Technische Univ. (1972). 204p. (In German).

Thesis.

The flow in the entrance region of a flat duct, a square channel, and in annular passages without magnetic field, as well as the MHD flow in the entrance region of a flat duct and in annular tubes are investigated, taking into account the Hall effect, the ion slip and the small magnetic Reynolds number. Furthermore, the thermal inlet flow with stationary MHD flow in flat ducts and in annular tubes is studied, considering viscous and electrical dissipation, as well as the simultaneous development of MHD velocity and temperature profiles in flat ducts and annular passages, disregarding dissipation. For all investigations, laminar steady flow, heat transfer due to conduction and forced convection, constant parameters and boundary conditions of the second kind with regard to the temperature are assumed, whereas the axial molecular momentum and heat transport is neglected. For solving the equation of momentum and the energy equation, the Kantorowitsch method is applied which allows a partial differential equation to be reduced to an ordinary differential equation. Analytical solutions are obtained for velocity and temperature for the cases of purely hydrodynamic inlet flow in flat ducts and in annular passages, and for thermal inlet flow in flat ducts and in annular passages without disspation. (GE)

4509 CHARACTERISTICS OF A PLANE ELECTROHYDRODYNAMIC WALL JET. Amasovich, Yu. I. Fluid Mech. - Sov. Res.; 2: 117-120(1973).

The problem of propagation of a plane laminar electrohydrodynamic wall jet above a conducting plate is examined in the one-dimensional approximation. The electrohydrodynamic boundary layer is assumed to have a finite thickness. The problem is solved by the Shvets method, suggested for solving equations of the hydrodynamic boundary layer. The final solution is found by computer by the numerical Runge–Kutta method. (auth)

4510 JET FLOWS IN AN ELECTRIC ARC. Shcherbinin, E. V. Magn. Gidrodin.; No. 4, 66-72(1973). (In Russian).

The precise problem on flows in arcs appearing under the effect of an electromagnetic force in the pre-electrode region is formulated. The solution in the linear approximation is carried out for two cases: linear electrode and point electrode placed on a two-dimensional surface. (tr-auth)

4511 EFFECT OF A LONGITUDINAL MAGNETIC FIELD ON STATISTICAL CHARACTERISTICS OF MERCURY PIPE FLOW TURBULENT TEMPERATURE FLUCTUATIONS. Genin, L. G.; Manchkha, S. P.; Sviridov, V. G. Magn. Gidrodin.; No. 4, 31-37 (1973). (In Russian).

The intensity of the temperature fluctuations, self-correlation and spectral functions, and correlation functions were measured in the transverse direction during Hg flow in circular pipes in the Reynolds number range from 7×10^3 to 5×10^4 and Hartmann numbers up to 550 at heat flux densities from 0.5×10^4 to 3×10^4 W/m^2. The correlation functions in the longitudinal direction were calculated from the self-correlation functions by means of the Taylor hypothesis. From the measurements it was shown that at distances of about 21 diameters from the beginning of the zone with homogeneous magnetic field in the flow a high level of intensity of temperature fluctuation is maintained even at supercritical values of the Ha/Re parameter. Low-frequency perturbations expanding along the magnetic field remain. (tr-auth)

4512 ELECTROMAGNETIC PROCESSES IN A PLASMA FLOWING IN A RECTANGULAR CHANNEL IN AN EXTERNAL TRAVELING MAGNETIC FIELD. Rashchenkin, A. P. Magn. Gidrodin.; No. 4, 94-101(1973). (In Russian).

The characteristics of the electromagnetic processes in plasma flow are studied with a consideration of the Hall phenomenon in the external traveling magnetic field. Under some simplifying assumptions the effect of the anisotropy of the electroconducting plasma on the size of the current and voltage in the channel is found. A comparative analysis is made of the processes in the plasma for three cases: for channels with non-conducting side walls, for channels with conducting side walls, and for channels with sectioned electrodes on the side walls. It is shown that in channels with non-conducting walls and with sectioned electrodes a significant longitudinal voltage potential can be induced in the plasma which must be considered in actual installations. In channels with side walls conducting electric current the longitudinal voltage potential is suppressed. (tr-auth)

4513 GREEN FUNCTION FOR AN AXIAL-SYMMETRIC MHD STOKES FLOW IN SEMISPACE. Tsinober, A. B. Magn. Gidrodin.; No. 4, 144-146(1973). (In Russian).

The Green function is found for an axial-symmetric MHD Stokes flow in semispace. By means of this function it is shown that at $Ha/Re \gg 1$ the solution of the non-linear motion equation differs little from the solution of the linear problem. (tr-auth)

4514 CONDUCTING VISCO-PLASTIC BOUNDARY LAYER WITH A STEP VELOCITY DISTRIBUTION ALONG THE EXTERNAL BOUNDARY IN A TRANSVERSE MAGNETIC FIELD. Kosachevskaya, E. A.; Tatarchenko, E. N. Magn. Gidrodin.; No. 4, 146-148 (1973). (In Russian).

The self-similar solution of the problem on the stationary visco-plastic boundary layer in a inhomogeneous transverse magnetic field with step velocity distribution along the external boundary is examined. The problem is solved in the non-inductive approximation. The possibility of slippage on the solid walls is calculated. (tr-auth)

4515 CALCULATION OF THE ELECTRIC FIELD IN MHD GENERATOR CHANNELS WITH HALL EFFECT BY THE METHOD OF VORTEX SOURCE IMAGES. Poberzhskii, L. P.; Yakhot, A. O. Magn. Gidrodin.; No. 4, 102-110(1973). (In Russian).

An approximation method is proposed for the calculation of the electric field in MHD generator channels with movable cylindrical electrodes in the flow. Expressions are derived for the matrix coefficients of the intrinsic and mutual resistance. It is shown that during movement of the electrodes in the current the internal resistance increases because of the circulation of the Hall current and in the vicinity of the small dimension electrodes a reduction of the voltage potential occurs caused by current constriction. (tr-auth)

4516 THREE-DIMENSION LIQUID AND GAS FLOW IN ANNULAR CHANNELS AT LARGE INTERACTION PARAMETERS. Kovalev, L. K.; Koneev, S. M. A. Magn. Gidrodin.; No. 4, 84-93 (1973). (In Russian).

The three-dimensional MHD flow of liquids and gases in axially symmetric annular channels is examined when the external asymmetric magnetic field is three-dimensional $B(B_r, B_\theta, B_z)$ and the MHD interaction parameters and the Euler numbers are much greater than unity. Under the assumption that the direction of the approximately constant magnetic field forms a small angle a with the axis of the channel an analytical solution is obtained for the problem in the zero 0(1) and first 0(a) approximations. The effect of the asymmetry of the magnetic field on the distribution of the pressure rate and current density in the annular channel is analyzed. The inhomogeneity of the flow intensity in the channel cross section is determined and the effect of the compressibility of the gas on the characteristics of the three-dimensional MHD flow is investigated. (tr-auth)

4517 MAGNETOHYDRODYNAMICS OF MICROSTRUCTURE MEDIA. Rheoelectric Effect. Suyazov, V. M. Magn. Gidrodin.; No. 4, 59-65(1973). (In Russian).

A system of equations describing the movement of a conducting isothermal fluid with deformed microstructure is written in the magnetohydrodynamic approximation with consideration of the mechanoelectric crossover effect. By use of a series of simplifying assumptions the problem on the stationary two-dimension Couette flow is examined. It is shown that during such flow in fluids in the absence of an external electromagnetic field currents are induced both in the direction of the motion and in directions perpendicular to the displacement. On the basis of the solution obtained a structural-continuous explanation is proposed for the appearance of a transverse electric current during the flow of the liquid in a viscometer (rheoelectric effect). (tr-auth)

4518 APPROXIMATION SOLUTION OF VISCO-PLASTIC BOUNDARY LAYER EQUATIONS IN A TRANSVERSE MAGNETIC FIELD. Kosachevskaya, E. A. Magn. Gidrodin.; No. 4, 55-58 (1973). (In Russian).

The steady flow of a conducting visco-plastic medium at the boundary layer at large Bingham numbers and with arbitrary distribution of the velocity and pressure at the outer boundary is examined. The magnetic field is perpendicular to the walls and there are random functions of the longitudinal coordinates. The modified Shvets method was used in particular for the solution of the equations. It is shown that cases of inhomogeneous magnetic fields and constant velocity and pressure at the outer boundary of the layer the approximation solution obtained is satisfactorily close to accurate. (tr-auth)

4519 SUPPRESSION OF LIQUID METAL INSTABILITY CONTROLLED BY MEANS OF A MAGNETIC FIELD. Gubarev, V. F.; Paslavskii, E. S. Magn. Gidrodin.; No. 4, 45-54(1973). (In Russian).

The stability of a liquid metal layer contained in a vacuum by a variable magnetic field of circular polarization is studied. A distributed system of automatic control is used for stabilization. The system consists of two controlling shells placed at a distance l from the upper and lower boundaries of the metal. The control system consists of a winding with amplifiers inserted in the winding. A closed system of equations describing the hydromagnetic oscillation of the liquid metal near the equilibrium state in the presence of controls is derived. The ranges of values of the amplification factor of the magnetic field guaranteeing the stable containment of some metals for different parameters are reported. (tr-auth)

4520 AXIS-SYMMETRICAL MHD STOKES FLOW IN A SEMISPACE. Tsinober, A. B. Magn. Gidrodin.; No. 4, 17-30(1973). (In Russian).

Two types of axially symmetrical flows in semispace are examined: jet discharge and flow over a rotating disc. In both cases solutions are obtained by means of Bessel transforms in the form of integrals containing Bessel functions. For point jets solutions are found in the final form. For flows of the first type solutions are also obtained in the Oseen approximation. In particular cases of flow over conducting discs the problem is reduced to a system of paired integral equations. These in turn are reduced to integral Fredholm second-order equations which can be integrated numerically. (tr-auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 3378 and 4588.

4521 (RHEL-72-1(Vol. 1)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON HIGH ENERGY COLLISIONS (STONY BROOK SERIES), OXFORD, ENGLAND, APRIL 5-7, 1972. Volume 1. Smith, J. R. (ed.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1972. 509p. (CONF-720419-P1).

The conference included nine papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 4522, 4526, 4527, 4544-4546, 4597, 4664, and 4729.

4522 (RHEL-72-1(Vol. 1), pp 253-413) REVIEW OF MANY-BODY INTERACTIONS AT HIGH ENERGY. Morrison, D. R. O. (CERN, Geneva). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The review of many-body interactions at high energy covers the results of the collision of two high energy particles, the aims and results of the experiments, experiments to discriminate between different theories and models, the progress since 1967. (JFP)

Electromagnetic

4523 (CONF-720724-P2, pp 103-111) METHOD FOR DETECTION OF ANTINEUTRON ANNIHILATION IN NUCLEAR EMULSIONS UNDER ISR CONDITIONS. Friedlaender, E. M.; Haiduc, M. (Inst. for Atomic Physics, Bucharest). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Antineutrons can be detected only through their annihilation star, and thus there exists the problem of distinguishing certain characteristic features of the antineutron stars from those of the (presumably) high background of the stars of a different provenience. A statistical procedure for tackling this problem under the specific conditions of ISR exposures is described. The features expected for an antineutron annihilation star and the main components of the background are presented. The estimation of the fraction of annihilation stars in the whole sample of apparently neutral stars in the emulsion was tested in a preliminary experiment. Even with low statistics an isotropic component could be detected; however, final conclusions can be drawn only after a new exposure with higher beam currents. (4 figures) (RWR)

4524 (DESY-74-5) ELECTROPRODUCTION IN A STREAMER CHAMBER: MULTIPLICITIES, INCLUSIVE CROSS SECTIONS, AND PRODUCTION OF ρ^0 AND ω MESONS. Eckardt, V.; Gebauer, H. J.; Joos, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Feb 1974. 63p. Dep. NTIS (US Sales Only) $6.25.

Hadron production by ep scattering in the kinematical region $0.3 < Q^2 < 1.5$ GeV^2 and $1.3 < W < 2.8$ GeV was studied with a streamer chamber at DESY. The average multiplicity of charged hadrons, $\langle n \rangle$, is consistent with a logarithmic s dependence: $\langle n \rangle = (0.79 \pm 0.11) + (0.93 \pm 0.06) \ln(\omega' - 1') + (1.04 \pm 0.08) \ln Q^2/m_p^2 \approx 0.8 + \ln s/m_p^2$. The multiplicity does not scale with respect to ω' or $\omega_{\gamma p}$. Inclusive π^- production was analyzed in terms of $(x, p_\perp^2)$ and $(M_{X'}t)$ as a function of Q^2,W and Q^2,ω'. In the central and the target fragmentation region no Q^2 dependence was found. The reduction of the π^- yield in the beam fragmentation region compared to photoproduction can be related to the smaller ρ^0 cross section in electroproduction. The normalized invariant π^- cross section, F(x), does not scale with respect to ω' in the kinematical range. In the nondiffractive region, $2.5 < \omega' < 10$, the slope of the $p_\perp^2$ distribution decreases with Q^2 for fixed ω'. In the diffractive region, $10 < \omega' < 15$, the effect is small. In the beam fragmentation region a longitudinal/transverse interference term was observed. The Q^2 dependence of $\sigma(\gamma_V p \to \rho^0 p)$ for $W > 2$ GeV is essentially determined by the ρ propagator as suggested by VDM. The slope of $d\sigma/dt$, for ρ^0 production at $\langle Q^2 \rangle = 0.4$ GeV^2 is smaller than at $Q^2 = 0$. For $W > 2.2$ GeV the ρ^0 polar decay angular distribution shows a nonzero longitudinal part, $r_{00}^{04} = 0.183 \pm 0.031$, while the distribution of the angle ψ, sensitive to linear photon polarization, implies dominant production by transverse photons. The s^- channel helicity flip amplitudes are small compared to nonflip amplitudes. Assuming SCHC for ρ^0 production $p = \sigma_L/\sigma_T = 0.260 \pm 0.054$ for $\langle W \rangle = 2.45$ and $\langle Q^2 \rangle = 0.5$ GeV^2 are found. Interference between production by longitudinal and transverse photons was found. Assuming SCHC and only natural parity exchange the phase between the two amplitudes was found to be $\cos\delta = 0.61 \pm 0.15$. A pronounced ω peak was seen in the reaction $\gamma_V p \to p\pi^+\pi^-\pi^0$. The Q^2 and W dependence of $\sigma(\gamma_V p \to \omega p)$ was determined. (auth)

4525 (LNF-73-63) MUON PAIR PRODUCTION BY PHOTON-PHOTON INTERACTION IN THE ADONE e^+e^- STORAGE RING. Barbiellini, G.; Ceradini, F.; Conversi, M.; d'Angelo, S.; Ferrer, M. L.; Orito, S.; Paoluzi, L.; Santonico, R.; Tsuru, T.; Visentin, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 20 Nov 1973. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

The photon-photon interaction was investigated by e^+ and e^- collisions at about 2.7 GeV total energy. Evidence based on 34 well identified events was obtained for the process $e^+e^- \to e^+e^-\mu^+\mu^-$, hitherto unobserved. Such a process is found to occur in agreement with theoretical predictions based on the equivalent photon approximation. Results on 74 events from process $e^+e^- \to e^+e^-e^+e^-$ are also reported. (auth)

4526 (RHEL-72-1(Vol. 1), pp 1-52) LEPTON-HADRON INTERACTIONS. Toner, W. T. (Rutherford Lab., Chilton, Eng.). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Inelastic electron scattering data is reviewed in which only the scattered electron is detected, the so-called single-arm experiments. Also experiments in which one or more of the hadrons produced in the interactions are detected in coincidence with the scattered electron are discussed. (JFP)

4527 (RHEL-72-1(Vol. 1), pp 53-86) PHOTON-HADRON INTERACTIONS. Meyer, H. (DESY, Hamburg). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The similarity of high energy photoproduction to hadron production is used as a basic guideline in a summary of evidence for the hadronic nature of the photon. The discussion covers vector meson production, total cross section measurements, inclusive photoproduction data, and pseudoscalar meson production. (JFP)

4528 MEASUREMENT OF THE Σ^- MAGNETIC MOMENT. Fox, J.D.; Lam, W.C. (Brookhaven Natioanl Laboratory, Upton, New York 11973); Barnes, P.D.; Eisenstein, R.A.; Miller, J.; Sutton, R.B.; Jenkins, D.A.; Eckhause, M.; Kane, J.R.; Roberts, B.L.; Welsh, R.E.; Kunselman, A.R. Phys. Rev. Lett. 31: No. 17, 1084-1087 (22 Oct 1973).

We have observed x rays produced in atoms formed by Σ^- hyperons with both lead and uranium nuclei. The fine-structure splitting of the x rays can be used to determine the magnetic moment of the Σ^- particle by a method similar to that used in a recent measurement of the $\bar{p}$ magnetic moment. Although the fine-structure splitting for the Σ^- atom was not distinctly resolved, our measurement can place an upper limit on the fine-structure splitting and hence the magnetic moment. We find that the magnetic moment lies in the range $-1.6 < \mu < 0.8$ in nuclear magneton units. (auth)

4529 ELECTRON-POSITRON INTERACTIONS AT E(CM) = 4 GeV AT THE CAMBRIDGE ELECTRON ACCELERATOR. Madaras, R. (Ecole Normale Superieure, Orsay, France). pp 41-72 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The results of an experiment performed with the e^+e^- storage device of the Cambridge Electron Accelerator are presented. The experiment was carried out at 4 GeV (center of mass system). The BOLD large angle detector was used without a magnetic field to detect final electromagnetic and hadronic states in e^+e^- interactions. Measurements made of $e^+e^- \to e^+e^-$ and $e^+e^- \to \gamma\gamma$ interactions constitute the best currently available test of the validity of QED at large momentum transfer. Measurements of the $e^+e^- \to$ multihadron reaction yielded a total cross section greater than that of the $e^+e^- \to \mu^+\mu^-$ reaction. (FR)

4530 EXPERIMENTAL RESULTS ON HADRON PRODUCTION IN INELASTIC ELECTRON SCATTERING. Meyer, H. (Deutsches Elektronen-Synchrotron, Hamburg). pp 135-160 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

Recent photoproduction and electroproduction results in the three following fields are presented: electroproduction of ρ mesons; production of protons, pions, and kaons in inclusive reactions; and charged hadron multiplicity distributions. (FR)

4531 SOME DIFFERENTIAL CROSS SECTION FOR NEUTRAL PION PHOTOPRODUCTION IN THE PHOTON ENERGY RANGE 350 TO 850 MeV. Dougan, P.; Kivikas, T.; Lugner, K.; Ramsay, V.; Stiefler, W. (Univ. of Lund, Sweden). Phys. Lett., 49B: No. 2, 194-196(1 Apr 1974).

The preliminary results of measurements of differential cross sections for the photoproduction of neutral pions from protons are given. The data fall in the range 60-125 degrees in pion c.m. angle and 350 to 850 MeV in photon energy. (auth)

4532 PHOTOPRODUCTION OF NEUTRAL PIONS OFF HYDROGEN AT PHOTOENERGIES BETWEEN 0.55 AND 2.2 GeV AT A CM-ANGLE OF 120°. Feller, P.; Herr, H.; Hilger, E.; Kadansky, V.; Menze, D.; Miczaika, T.; Opara, U.; Schwille, W. J. (Univ., Bonn). Phys. Lett., 49B: No. 2, 197-200(1 Apr 1974).

The differential cross section was measured for the reaction $\gamma + p \rightarrow \pi^0 + p$ at the Bonn 2.5 GeV electron synchrotron in the energy range from 0.55 to 2.2 GeV at a c.m. angle of 120 degrees. (auth)

Weak

Refer also to abstract 3389.

4533 K_{e3}^0 CHARGE ASYMMETRY. Fitch, V.L.; Hepp, V.; Jensen, D.; Strovink, M.; Webb, R.C. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 31: No. 25, 1524-1527 (17 Dec 1973).

We have measured the charge asymmetry in K_{e3}^0 decay and searched for variations in the asymmetry across the Dalitz plot. Ascribing any variation to a T-noninvariant form factor, we find $Im\lambda = 0.001 \pm 0.025$. The integrated asymmetry is $(N^+ - N^-)/(N^+ + N^-) = (3.18 \pm 0.38) \times 10^{-3}$. (auth)

4534 MEASUREMENT OF THE LEPTON CHARGE ASYMMETRY IN $K_L^0 - \pi^\pm l^\mp \nu$ DECAYS. Williams, H.H.; Larsen, R.C.; Leipuner, L.B.; Sapp, W.W.; Sessoms, A.L.; Smith, L.W. (Brookhaven National Laboratory, Upton, New York 11973); Adair, R.K.; Turner, R.C. Phys. Rev. Lett. 31: No. 25, 1521-1524 (17 Dec 1973).

We have made a measurement of the lepton charge asymmetry in K_L^0 decays. Magnetic analyses of the decay products in a spectrometer using multiwire proportional counters allowed kinematic reconstruction of the event where the particles traversed only 293 mg of matter. The leptons were differentiated from the pions only through their different transverse-momentum distributions. The asymmetry was measured to be $(3.33 \pm 0.50) \times 10^{-3}$, in accord with the superweak description of CP nonconservation. (auth)

4535 REINES EXPERIMENT AND LIMITATIONS ON νe INTERACTION CONSTANTS. Tolokonnikov, S. V.; Fayans, S. A. (Inst. of Atomic Energy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2667-2669(Dec 1973). (In Russian).

The values obtained by the Reines' group on the cross section of elastic scattering of the antineutrino on the electron are compared with the theoretical limitations of the constants of νe interactions. (JSR)

4536 KNOCK-ON ELECTRONS OF RELATIVISTIC MUONS IN A MEDIUM-Z ELEMENT. Bhattacharyya, D. P. (Presidency Coll., Calcutta). Indian J. Pure Appl. Phys.; 11: No. 6, 424-425 (Jun 1973).

A cloud chamber study on the variation of knock-on electron production cross section in a medium Z element on the muon momenta ≤ 1.7 GeV/c was done. It is found that the knock-on electron production cross section increases slowly with muon momentum, and the experimental results are in good agreement with the values calculated after the theory of H. J. Bhabha [Proc. R. Soc., A164 (1938), 227]. (auth)

4537 NEUTRINO–DEUTERON INTERACTION CROSS SECTIONS AT LAMPF ENERGIES. Brolley, J. E.; Huffman, A. H. pp 882-885 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Measurement of neutrino fluxes at the Los Alamos Meson Facility (LAMPF) may be practicable if mediated by the process $\nu + D \rightarrow 2p + e^-$. The energy spectrum of neutrinos from the LAMPF beam dump will extend up to approximately 53 MeV. The calculation of Weneser (1957) may be expected to be germane for this energy interval. This calculation is modified by introducing proton and deuteron wave functions fitted to more recent data, meson exchange corrections, and a recently determined value of the relevant coupling constant. (auth)

Strong (Baryon-induced)

Refer also to abstracts 4450 and 4858.

4538 (CONF-720724-P2, pp 184-189) DOUBLE MARKED FRAGMENTS. Juric, M.; Popov, S.; Adamovic, O. (Inst. of Physics, Belgrade). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Hypernuclei (HN) containing hammer tracks among the decay products were analyzed. The HN were produced by slow K^- mesons' interacting with emulsion nuclei. Analysis of the HN with a hammer indicates that about 90% of mesic HN (MHN) and 67% of nonmesic HN (NMHN) originate from the interaction of K^- mesons with a light emulsion nucleus. The binding energy of the lambda in Be^{10} was found to be (9.296 ± 0.264) MeV. The most frequent MHN with hammer was ^{8}Be, ^{8}Li and ^{8}B hammers from MHN are emitted with equal probability, but ^{8,9}Li are dominant in the case of NMHN. The range distribution of hammer tracks and the energy distribution of alpha particles from the hammers are shown. (2 figures, 2 tables) (RWR)

4539 (COO-3072-23) PRELIMINARY OBSERVATION OF HIGH TRANSVERSE MOMENTUM PARTICLE PRODUCTION AT NAL. Boymond, J. P.; Piroue, P. A.; Sumner, R. L.; Cronin, J. W.; Frisch, H. J.; Shochet, M. J. (Princeton Univ., N. J. (USA); Chicago Univ., Ill. (USA)). 1973. 10p. (CONF-730943-14). Dep. NTIS $4.00.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The yields of particles produced as a function of transverse momentum in proton-nucleus collisions were measured. The observations were made in the region of 90° in the center of mass system of the incident proton and a single nucleon at rest. Preliminary results from a tungsten target bombarded by 200 and 300 GeV protons are reported. (auth)

4540 (JINR-P1-7730) ENERGY AND ANGULAR SPECTRA OF PROTONS EMITTED IN π^- + Xe INTERACTIONS AT 3.5 GeV/c. Strugal'skii, Z. S.; Plyuta, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

The results are presented of experimental study of the energy and angular characteristics of protons emitted in π^- + Xe interactions at 3.5 GeV/c. The dependences of the characteristics on the number of generated π^0-mesons are obtained. (auth)

4541 (JINR-P1-7846) OBSERVATION OF ANTITRITIUM. Baldin, B. Yu.; Vertogradov, L. S.; Grishkevich, Ya. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 32p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

Four cases of the production of nuclei of a new element—antitritium—were identified in an experiment performed by the electronic technique in the negative-particle beam of 25 GeV/c at U-70 (IHEP, Serpukhov). Production cross section of $^3\bar{H}$ nuclei was found to be $d^2\sigma/d\Omega dP$ [$(0^0, 25$ GeV/c$) = (1.0 \pm 0.6) \cdot 10^{-35}$] cm^2/[sr · GeV/c · Al nucleus]. (10 figures, 2 tables) (auth)

4542 (LUIP-CR-73-14) FAST HELIUM NUCLEI IN INTERACTIONS INDUCED BY VERY HEAVY NUCLEI. Jakobsson, B.; Kullberg, R.; Otterlund, I. (Lund Univ. (Sweden). Fysiska Institutionen). Dec 1973. 31p. Dep. NTIS (US Sales Only) $4.75.

Fast helium nuclei emitted in interactions between heavy cosmic ray nuclei ($12 \leq Z \leq 26$) and photoemulsion nuclei at energies >1 GeV/nucleon were studied. Comparisons with interactions where the incident particles are protons, pions or light nuclei reveal some characteristic features of nucleus-nucleus interactions. The frequency of fast target helium nuclei is much larger and the high energy tail of the energy spectrum of these helium nuclei is more pronounced in nucleus-nucleus interactions than in proton-nucleus and pion-nucleus interactions. The number of helium nuclei emitted depends on the size and disintegration of the interacting nuclei. In order to explain the experimental data several possible production mechanisms have to be considered. Some characteristics of the emission of multiply-charged projectile fragments were also studied. (auth)

4543 (NAL-73/20-EXP) PP INTERACTIONS AT 303 GeV/c; TESTS OF SCALING IN SINGLE PARTICLE π^{-+} AND PROTON DISTRIBUTIONS. Dao, F. T.; Gordon, D.; Lach, J.; Malamud, E.;

Schivell, J.; Meyer, T.; Poster, R.; Schlein, P. E.; Slater, W. E. (National Accelerator Lab., Batavia, Ill. (USA); California Univ., Los Angeles (USA)). Jun 1973. 8p. Dep. NTIS $4.00.

Results of single π^+, π^-, and proton invariant cross section distributions are presented from p + p interactions at 303 GeV/c in a bubble chamber. The various distributions are shown. (JFP)

4544 (RHEL-72-1(Vol. 1), pp 127-176) TOTAL CROSS SECTIONS AND ELASTIC SCATTERING AT HIGH ENERGIES. Diddens, A. N. (CERN, Geneva). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The properties of high energy hadron–hadron scattering are reviewed, and the latest data are shown. Total cross sections, elastic and charge-exchange scattering in the region $t \leq 0.5$ GeV^2, at large t, and in the backward direction are covered. (JFP)

4545 (RHEL-72-1(Vol. 1), pp 177-214) RESULTS OF EXPERIMENTS ON INCLUSIVE REACTIONS AT THE CERN INTERSECTING STORAGE RINGS. Sens, J. C. (CERN, Geneva). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The summary of the results include single-particle angular distributions, π^+ and π^- angular and momentum distributions, distribution in momentum for π^0, $\bar{p}$ and p at 90°, particle ratios, multiplicities, and a quark search. (JFP)

4546 (RHEL-72-1)Vol. 1), pp 215-251) QUASI-TWO-BODY AND TWO-BODY INELASTIC HADRONIC INTERACTIONS. Barloutaud, R. (CEN, Saclay, France). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

Results on quasi-two-body inelastic hadronic interactions are reviewed to determine whether they answer questions on whether the diffractive mechanism is completely forbidden for all class I reactions considered previously as nondiffractive processes, whether diffraction dissociation reactions are quasi-two-body reactions, and the possible existence of other quasi-two-body processes involving narrow high mass mesonic resonances. (JFP)

4547 CHARACTERISTICS OF THE REACTION $p + p \rightarrow p + X$ AT 205 GeV/c. Barish, S. J.; Colley, D. C.; Schultz, P. F. (Argonne National Laboratory, Argonne, Illinois 60439); Whitmore, J. Phys. Rev. Lett. 31: No. 17, 1080-1083(22 Oct 1973).

The inelastic reaction p+p–p+X is studied at 205 GeV/c. The distribution of the square of the missing mass, M^2, shows a large diffractivelike peak at low M^2 due to two–, four–, and six–prong events. The slope of the invariant cross section versus t decreases with increasing M^2. The energy dependences of the multiplicity moments for the recoiling system X are similar to those for corresponding moments for p+p→ (n charged particles). (auth)

4548 SEARCH FOR QUARKS AND HEAVY STABLE PARTICLES PRODUCED AT 300 GeV. Leipuner, L.B.; Larsen, R.C.; Sessoms, A.L.; Smith, L.W.; Williams, H.H. (Brookhaven National Laboratory, Upton, New York 11973); Kellogg, R.; Kasha, H.; Adair, R.K. Phys. Rev. Lett. 31: No. 19, 1226-1229 (5 Nov 1973).

We report a search for quasistable particles with anomalous charge or large mass produced by the interaction 300-GeV protons at the National Accelerator Laboratory. Analyses of energy losses in a counter telescope lead to cross-section limits of 10^{-35} cm^2 for particles with charges of e/3 and 2e/3 and 5×10^{-31} cm^2 for charge-4e/3 particles. Time-of-flight measurements gave cross-section limits of about 10^{-31} cm^2 for the production of massive charged particles. (auth)

4549 MEASUREMENT OF THE SLOPE OF THE DIFFRACTION PEAK FOR ELASTIC p-p SCATTERING FROM 8 TO 400 GeV. Bartenev, V.; Kuznetsov, A.; Morozov, B.; Nikitin, V.; Pilipenko, Y.; Popov, V.; Zolin, L. (The State Committee for Utilization of Atomic Energy of the U.S.S.R., Moscow, U.S.S.R.); Carrigan, R.A. Jr.; Malamud, E.; Yamada, R.; Cool, R.L.; Goulianos, K.; Chiang, I.; Melissinos, A.C.; Gross, D.; Olsen, S.L. Phys. Rev. Lett. 31: No. 17, 1088-1091 (22 Oct 1973).

The slope b(s) of the forward diffraction peak of p–p elastic scattering has been measured in the momentum-transfer-squared range $0.005 \lesssim |t| \lesssim 0.09$ (GeV/c)^2 and at incident proton energies from 8 to 400 GeV. We find that b(s) increases with s, and in the interval $100 \lesssim s \lesssim 750$ (GeV)^2 it can be fitted by the form $b(s) = b_0 + 2\alpha' \ln s$ with $b_0 = 8.23 \pm 0.27$, $\alpha' = 0.278 \pm 0.024$ (GeV/c)$^{-2}$. (auth)

4550 MEASUREMENT OF p+p–p+X BETWEEN 50 AND 400 GeV. Abe, K.; DeLillo, T.; Robinson, B.; Sannes, F. (Rutgers University, New Brunswick, New Jersey 08903); Carr, J.; Keyne, J.; Siotis, I. Phys. Rev. Lett. 31: No. 25, 1527-1530 (17 Dec 1973).

We present measurements of the invariant cross section for the inclusive reaction p+p–p+X in the region $0.14 < |t| < 0.38$ GeV^2, $100 < s < 750$ GeV^2, and $0.80 < x < 0.93$. (auth)

4551 DETERMINATION OF TRIPLE REGGE COUPLINGS FROM A STUDY OF THE REACTION p+p–p+X BETWEEN 50 AND 400 GeV. Abe, K.; DeLillo, T.; Robinson, B.; Sannes, F. (Rutgers University, New Brunswick, New Jersey 08903); Carr, J.; Keyne, J.; Siotis, I.; Pagnamenta, A. Phys. Rev. Lett. 31: No. 25, 1530-1533 (17 Dec 1973).

We present an analysis, in the framework of the triple Regge model, of our recent experimental results on the reaction p+p–p+X between 50 and 400 GeV. (auth)

4552 PRODUCTION OF HADRONS WITH LARGE TRANSVERSE MOMENTUM AT 200 AND 300 GeV. Cronin, J.W.; Frisch, H.J.; Shochet, M.J. (The Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637); Boymond, J.P.; Piroué, P.A.; Sumner, R.L. Phys. Rev. Lett. 31: No. 23, 1426-1429 (3 Dec 1973).

Differential cross sections as a function of transverse momentum are presented for the production at ~90° (in the c.m. system) of $\pi^\pm$, $K^\pm$, p, and $\bar{p}$ in p–nucleus collisions at incident proton energies of 200 and 300 GeV. (auth)

4553 REAL PART OF THE PROTON–PROTON FORWARD-SCATTERING AMPLITUDE FROM 50 TO 400 GeV. Bartenev, V.; Carrigan, R.A. Jr.; Chiang, I.; Cool, R.L.; Goulianos, K.; Gross, D.; Kuznetsov, A.; Malamud, E.; Melissinos, A.C.; Morozov, B.; Nikitin, V.; Olsen, S.L.; Pilipenko, Y.; Popov, V.; Yamada, R.; Zolin, L. (The State Committee for Utilization of Atomic Energy of the U.S.S.R., Moscow, U.S.S.R.). Phys. Rev. Lett. 31: No. 22, 1367-1370 (26 Nov 1973).

From measurements of proton–proton elastic scattering at very small momentum transfers where the nuclear and Coulomb amplitudes interfere, we have deduced values of ρ, the ratio of the real to the imaginary forward nuclear amplitude, for energies from 50 to 400 GeV. We find that ρ increases from -0.157 ± 0.012 at 51.5 GeV to $+0.039 \pm 0.012$ at 393 GeV, crossing zero at 280 ± 60 GeV. (auth)

4554 OBSERVATION OF INCREASING CHARGED MULTIPLICITY AS A FUNCTION OF TRANSVERSE MOMENTUM IN 28.5-GeV/c PP INTERACTIONS. Ramanauskas, A.; Anderson, E.W.; Fisher, G.P.; Hien, N.C.; Lazarus, E.; Moy, K.M.; Schübelin, P.; Thorndike, A.M.; Turkot, F.; von Lindern, L. (Brookhaven National Laboratory, Upton, New York 11973); Clifford, T.S.; Collins, G.B.; Ficenec, J.R.; Gilbert, D.R.; Schreiner, W.M.; Stringfellow, B.C.; Trower, W.P.; Erwin, A.R.; Larson, G.P.; Gutay, L.J.; Laasanen, A.; Stanfield, K.; Willmann, R.B.; Harvey, E.; Selove, W. Phys. Rev. Lett. 31: No. 22, 1371-1374 (26 Nov 1973).

We have measured the mean charged multiplicity $\bar{n}_{CH}$ as a function of transverse momentum $p_\perp$ of the forward proton in the reaction p+p–p+MM for five intervals of missing mass (MM) using our Multiparticle Argo Spectrometer System. We observe an increase of $\bar{n}_{CH}$ for $p_\perp > 1$ GeV/c. (auth)

4555 EVIDENCE FOR SCALING OF SEMI-INCLUSIVE CROSS SECTIONS BETWEEN 13 AND 205 GeV/c. Ma, Z.M. (Michigan State University, East Lansing, Michigan 48823); Englemann, R.; Singer, R.; Voyvodic, L.; Whitmore, J. Phys. Rev. Lett. 31: No. 21, 1320-1322 (19 Nov 1973).

Semi-inclusive invariant cross sections for π^- produced in pp interactions at 205 GeV/c are compared, at fixed $n/\langle n \rangle$, with data at lower energies ranging from 13 to 28.4 GeV/c. Except in the central region ($x \simeq 0$), the data are found to be in good agreement with the predictions of Koba, Nielsen, and Olesen for semi-inclusive scaling. (auth)

4556 CROSS SECTIONS AND CHARGED-PARTICLE MULTIPLICITIES AT 102 AND 405 GeV/c. Bromberg, C.; Chaney, D.; Cohen, D.; Ferbel, T.; Slattery, P.; Underwood, D. (University of Rochester, Rochester, New York 14627); Chapman, J.W.; Cooper, J.W.; Green, N.; Roe, B.P.; Seidl, A.A.; Vander Velde, J.C. Phys. Rev. Lett. 31: No. 26, 1563-1566 (24 Dec 1973).

We have measured the total inelastic cross section (σ_{inel}) and charged-particle multiplicities obtained in pp collisions at 405 GeV/c. The data are from a preliminary 12000-picture bubble-chamber exposure. We find $\sigma_{inel} = 32.8 \pm 1.0$ mb; the low moments of the multiplicity distribution for negative particles are $\langle n^- \rangle = 3.50 \pm 0.07$, $D^- = 2.37 \pm 0.05$, $f_3^- = 2.1 \pm 0.2$, and $f_3^- = 0.1 \pm 0.9$. We also present updated results at 102 GeV/c. (auth)

4557 MISSING-MASS DEPENDENCE OF SOME CORRELATION PARAMETERS IN PROTON–PROTON INTERACTION AT 28.5 GeV/c. Ochiai, F. (Himeji Inst. of Tech., Japan); Homma, Y.; Kusumoto, O.; Okabe, H.; Teranaka, M.; Konishi, T.; Yokoto, J. Lett. Nuovo Cim.; 9: No. 11, 432-434(16 Mar 1974).

Some preliminary results are presented of the analysis on a correlation between charged particles produced in the 28.5 GeV/c proton–proton inelastic interaction. Correlation parameters specified by charge multiplicity are studied as a function of the missing mass of the recoil proton. The scaling behavior is also examined. (LBS)

4558 SOME OBSERVATIONS ON THE DIFFERENTIAL CROSS SECTIONS FOR $\bar{p}p \rightarrow K^-K^+$. Eisenhandler, E. (Queen Mary Coll., London); Gibson, W. R.; Hojvat, C. Phys. Lett.; 49B: No. 2, 201-204(1 Apr 1974).

Legendre coefficients are presented from fits to the differential cross sections for $\bar{p}p \rightarrow K^-K^+$ in the momentum range 0.8 to 2.4 GeV/c. The s-dependence of the cross sections at small angles is examined for evidence of Reggeized baryon exchange, and a fit made to this channel and backward K^+p elastic scattering. Comparisons are made with $\bar{p}p \rightarrow \pi^-\pi^+$. (auth)

4559 p–d FINAL STATE COULOMB INTERACTION FROM $^2H(\alpha,dt)^1H$ WITH e_α = 70 MeV. Lambert, J. M.; Treado, P. A.; Petersen, E. L.; Kane, R. J.; Beach, L. A. pp 725-728 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Striking evidence for a strong p-d final state Coulomb interaction (FSCI) was observed with the $^2H(\alpha,dt)^1H$ reaction in a coplanar, kinematically complete experiment. Identified particle and coincidence energy information for the d and t with angle pairs θ_d, θ_t = 14, 10 and 15.4, 12 was obtained. Such an experiment has the distinct advantages of determining the kinematics of the final state and, with proper selection of the kinematical variables, of distinguishing the final state interaction of interest from other interactions and sequential or quasifree scattering processes. The FSCI reproduced the experimentally observed features of the cross section rather well. The presence of sequentiallity and the insensitivity of the fitting to the effective range parameters limited the interpretation of the p-d FSI. The fits generated suggest that no ^{3}He excited state exists near its p-d breakup threshold. (auth)

4560 STATE OF THE EXPERIMENTAL PROGRAM AT SIN. Locher, M. P. pp 766-774 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

This discussion is confined generally to those experiments of the future SIN program which have some relevance to few body problems. The main section of the accelerator is an isochronous ring cyclotron for protons of 590 MeV energy and 100 μA current. The planned experiments discussed include elementary particle interactions (elastic πN and NN scattering); reactions with light nuclei, and other processes with less direct relation to few body questions. (NL)

4561 RESEARCH ON FEW PARTICLE SYSTEMS AT LAMPF. Simmons, J. E. pp 775-795 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A summary is given concerning the scope of proposals for future research on few particle systems at LAMPF, together with discussion of selected subjects. The relevance of deuteron polarization measurements is mentioned, and a possible discrepancy is noted concerning knowledge of the forward p-p amplitudes at medium energy. (auth)

4562 QUASIFREE INTERACTIONS IN THE COLLISIONS OF FAST PIONS WITH ATOMIC NUCLEI. Slovinskii, B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 595-599(Mar 1974). (In Russian).

The main results of the investigation of π–Xe interactions accompanied by the emission of a small number of secondary charged particles are presented in the GeV energy region. A simple statistical interpretation of the data is given. (auth)

4563 REACTIONS AT HIGH ENERGIES. pp 662-680 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Nineteen papers on this topic are presented. Subjects examined included the following: a coupled-channel treatment of baryon resonances in nuclei; the p–p interaction potential; Λ–n scattering length and the K^- + d interaction; inelastic sum rules for electron and hadron scattering; nucleon knock-out; Glauber calculations for elastic scattering of medium-energy light particles; high-energy proton elastic scattering; p-wave ππ interactions; pd → dp and pp → $d\pi^+$ interactions with N and N* exchanges; π^- absorption by ^{6}Li; pion–nucleus inelastic scattering; microscopic description of pion-induced reactions; pion photoproduction in ^{12}C in shell and Helm models; resonance model for pion-induced nucleon knock-out; high-energy C and O reactions; pd backward elastic scattering at 3.43 to 6.6 GeV/c; ^{4}He(γ,pπ) for high nuclear recoil momentum; reaction of fast π^- with ^{60}Ni; and production of hypernuclei by K^- in flight. (RWR)

4564 SOME EXAMPLES OF ASSOCIATED CHARGED PARTICLE MULTIPLICITIES IN PROTON–PROTON COLLISIONS AT 19 GeV/c. Boeggild, H.; Dahl-Jensen, E.; Hansen, K. H.; Hooper, J. E.; Lohse, E.; Motensen, B. N.; Moeller, R.; Harreskov Nielsen, J. (Univ. of Copenhagen). Nucl. Phys.; B72: No. 2, 221-227(1974).

19 GeV collisions in the CERN 2 meter hydrogen bubble chamber have been investigated for the number of prongs associated with an observed p, Λ, π^- or K^0_s with specified cms momentum components. For p and Λ the associated charged particles have been classified according to their longitudinal direction relative to the observed p and Λ. (auth)

4565 MULTIPLICITIES, TOPOLOGICAL CROSS SECTIONS, AND SINGLE PARTICLE INCLUSIVE DISTRIBUTIONS FROM pp INTERACTIONS AT 12 AND 24 GeV/c. Bonn-Hamburg-Munich-Collaboration. Nucl. Phys.; B69: No. 3, 454-492(1974).

Results on multiplicities, topological cross sections, total particle production cross sections, and correlations between charged particle and π^0 production are presented for pp interactions at 12 and 24 GeV/c incident laboratory momentum. Inclusive production of $\pi^\pm$, K^0_s, p, Λ, $\Sigma^\pm$ and $\bar{\Lambda}$ is studied; particle spectra are shown in single and double differential form and are compared, in different kinematic regions, with data obtained at other incident momenta and with other beam particles. (auth)

Strong (Meson-induced)

Refer also to abstracts 3391 and 4689.

4566 DIRECT EVIDENCE FOR THE S* MESON NEAR THE KK̄ THRESHOLD. Binnie, D.M.; Carr, J.; Debenham, N.C.; Duane, A.; Garbutt, D.A.; Jones, W.G.; Keyne, J.; Siotis, I. (Imperial College, London, England); McEwen, J.G. Phys. Rev. Lett. 31: No. 25, 1534-1537 (17 Dec 1973).

We report observation of the S* meson in the reaction $\pi^- + p \rightarrow S^* + n$. The S* decays into ππ and KK̄ and is seen most clearly in the $2\pi^0$ channel. A fit to the data gives a sheet-II pole at $987 \pm 7 - i(24 \pm 7)$ MeV and a relative coupling $g_{s\rightarrow K\bar{K}}/g_{s\rightarrow\pi\pi}$ of 3.8 ± 1.0. (auth)

4567 π^-p INTERACTIONS AT 205 GeV/c: CROSS SECTIONS AND CHARGED-PARTICLE MULTIPLICITY. Bogert, D.; Hanft, R.; Huson, F.R.; Ljung, D.; Pascaud, C.; Pascaud, C.; Pruss, S.; Smart, W.M. (National Accelerator Laboratory, Batavia, Illinois 60510); Abrams, G.S.; Bingham, H.H.; Chew, D.M.; Daugéras, B.Y.; Fretter, W.B.; Friedberg, C.E.; Goldhaber, G.; Graves, W.R.; Johnson, A.D.; Kadyk, J.A.; Stutte, L.; Trilling, G.H.; Winkelmann, F.C.; Yost, G.P. Phys. Rev. Lett. 31: No. 20, 1271-1274 (12 Nov 1973).

Results are reported based on a study of 3114 π^-p events at 205 GeV/c in the National Accelerator Laboratory 30-in. bubble chamber. The measured π^-p total and elastic cross sections are 24.0 ± 0.5 and 3.0 ± 0.3 mb, respectively. The elastic differential cross section has a slope of 9.0 ± 0.7 GeV^{-2} for $0.03 \leq -t \leq 0.6$ GeV^2. The average charged-particle multiplicity for the inelastic events is 8.02 ± 0.12. (auth)

4568 TESTS OF BOUNDS OBTAINED FROM EXPERIMENTAL π - N POLARIZATION AND DIFFERENTIAL CROSS SECTION. Liu, Y. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario); Sakmar, I.A. Ann. Phys. (N.Y.) 77: No. 1, 414-430 (1 May 1973).

Bounds on quantities describing π–N scattering are considered, the input being the experimental information on polarization and differential cross section. Numerical investigation is made of the phase shift analysis, the Regge-pole model, etc. These bounds provide useful constraints in performing phase-shift analysis and in the choice of Regge parameters. (auth)

4569 STUDY OF δ^- MESON DECAYING INTO $\eta\pi^-$ WITH $\eta \rightarrow \gamma\gamma$. Upadhyay, P. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 11: No. 6, 425-426(Jun 1973).

In a preliminary analysis of $\eta\pi^-$ system with $\eta \rightarrow \gamma\gamma$, a broad enhancement near mass 990 MeV/c^2 is observed. It is produced in the interaction $\pi^-\rho \rightarrow \delta^-\rho$ with $\delta^- \rightarrow \eta\pi^-$ over the four-momentum transfer region from -0.38 to -0.79 (GeV/c)^2. No narrow peak at mass 962 MeV/c^2 is observed. (auth)

4570 CROSS SECTIONS FOR QUASI-TWO-BODY REACTIONS IN K^-p INTERACTIONS BETWEEN 1263 AND 1843 MeV/c. Berthon, A. (Coll. de France, Paris); Tristram, G.; Vrana, J.; Bacon,

T. C.; Brandstetter, A. A.; Butterworth, I.; Gopal, G. P.; Jones, P. S.; Litchfield, P. J.; Mandelkern, M.; Meyer, J.; Poulard, G.; Tallini, B.; Wojcik, W.; Zatz, J.; Strub, R. Nuovo Cim., 21A: No. 1, 146-167(1 May 1974).

The cross sections of quasi-two-body reactions produced in K^--proton interactions at 13 different energies in the centre-of-mass energy range 1.915 to 2.168 GeV are given. (auth)

4571 PRELIMINARY RESULTS OF THE MEASUREMENT OF THE (π^+,^{4}He) INTERACTION AT 115 AND 150 MeV. Busso, L.; Costa, S.; Garfagnini, R.; Piragino, G.; Barbini, R.; Guaraldo, C.; Scrimaglio, R. pp 886-887 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Some results on the $\pi^+ - {}^4$He interaction obtained exposing to the photoproduced pion beam of the LEALE Laboratori in Frascati a diffusion cloud chamber filled with He at 15 Atm are reported. This method allows one to collect consistent sets of data on both elastic and inelastic processes. (auth)

4572 MEASUREMENT OF THE SPECTRUM OF BACKWARD PHOTONS FROM RADIATIVE PION-PROTON SCATTERING AT 260 AND 295 MeV. Leung, K. C.; Arman, M.; Blasberg, D. J.; Haddock, R. P.; Nefkens, B. M. K.; Schrock, B. L.; Sober, D. I.; Sperinde, J. M. pp 892-895 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An experiment to study in some detail radiative pion-proton scattering near the $\Delta(1236)$ resonance for $\pi^+p \to \pi^+p\gamma$ is presented. The preliminary results of measurements of $\pi^+p \to \pi^+p\gamma$ at pion kinetic energies of 260 and 295 MeV and $\pi^-p \to \pi^-p\gamma$ at 295 MeV are given. Experimental cross sections are compared with various theoretical predictions. All measured cross sections agree well with a simple equation of the form $d\sigma/(d\tilde{\Omega}_\pi d\tilde{\Omega}_\gamma d\tilde{E}_\gamma) = \sigma_0/\tilde{E}_\gamma$. The ~ denotes a center-of-mass variable and σ_0 is the coefficient of the leading term in the soft photon approximation in the limit, as $E_\gamma \to 0$. (NL)

4573 MEASUREMENT OF CROSS SECTIONS OF THE REACTION $\pi^-p \to X^0n$ IN THE MOMENTUM RANGE UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Prokoshkin, Yu. D.; Razuvaev, E. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 19: No. 3, 608-613(Mar 1974). (In Russian).

Cross sections of the reaction $\pi^-p \to X^0n$, $X^0 \to 2\gamma$ are measured at the momenta of 32.5 and 48 GeV/c. To select the events of the reaction with the cross section as small as 0.05 mkbarn, the γ-ray spark spectrometer was used. Energy dependence of the cross section is of a power form ($\sim p^{-1.41\pm0.12}$). Comparing the zero angle differential cross sections for the reactions $\pi^-p \to X^0n$ and $\pi^-p \to \eta^0n$, a conclusion on the U(6) symmetry of the quark model is deduced. The octet-singlet mixing angle for the pseudoscalar mesons was determined, $\beta = -(20.6 \pm 2.2)^0$. (auth)

4574 STUDY OF THE REACTIONS $\pi^+p \to (\rho^0,\omega)\Delta^{++}$ at 13 GeV/c. Gaidos, J. A.; Hirata, A. A.; DeBonte, R. J.; Mulera, T. A.; Thompson, G.; Willmann, R. B. (Purdue Univ., Lafayette, IN). Nucl. Phys.; B72: No. 2, 253-282(1974).

Cross sections, differential cross sections, density matrix elements and statistical tensors are given for the reactions $\pi^+p \to (\rho^0,\omega)\Delta^{++}$ at 13.2 GeV/c. A discussion of the results in terms of particle exchanges, quark model or dipole coupling constraints, and the equal phase hypothesis is presented in some detail for the high statistics $\rho^0\Delta^{++}$ channel. (auth)

4575 SOME CHARACTERISTICS OF INCLUSIVE REACTIONS $\pi^-p \to \pi^\pm + \ldots$ and $\pi^-n \to \pi^\pm + \ldots$ AT p = 40 GeV/c. Alma-Ata-Bucharest-Budapest-Krakow-Dubna-Hanoi-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan-Bator-Warsaw Collaboration. Nucl. Phys.: B72: No. 2, 189-200(1974).

Data on inclusive reactions $\pi^-p \to \pi^\pm + \ldots$ and $\pi^-n \to \pi^\pm + \ldots$ at 40 GeV/c are presented. Inclusive cross sections of the reactions $\pi^-p \to \pi^\pm + \ldots$ at x = 0 normalized to the inelastic cross section coincide with the ISR results for pp interactions at 500-1500 GeV. A similar result has been obtained for the inclusive process $\pi^-p \to \gamma + \ldots$ as well. (auth)

4576 SIX-PRONG EVENTS PRODUCED IN π^-p INTERACTIONS AT 3.93 GeV/c. Zieminski, A.; Chaloupka, V.; Dobrzynski, L.; Ferrando, A.; Losty, M. J.; Montanet, L.; Paul, E.; Yaffe, D. (CERN, Geneva). Nucl. Phys.; B69: No. 3, 502-530(1974).

A detailed analysis is presented of about 6000 events belonging to the final states $p2\pi^+3\pi^-$, $p2\pi^+3\pi^-\pi^0$ and $n3\pi^+3\pi^-$ produced in π^-p interactions at 3.93 GeV/c. The main features of the data are found to be well approximated by the predictions of relativistic phase-space, in spite of copious resonance production amounting to approximately 80% of the cross section. The resonance fractions are estimated from a maximum likelihood fit to the data using a phenomenological model describing the peripheral production of resonances and the symmetrization of the wave-function with respect to identical pions. A study is also made of two pion correlations. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 4521, 5288, and 5320.

4577 (IFVE-STF-73-37) PARTICLE MOMENTUM CUT-OFF IN INCLUSIVE PROCESS IN THE LARGE ANGLE REGION. Ezhela, V. V.; Logunov, A. A.; Mestvirishvili, M. A.; Petrov, V. A.; Rcheulishvili, G. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 11p. INIS.

It is shown that local analyticity and unitarity lead to logarithmic cut-off of particle momentum detected in binary inclusive process in the region of large angles. (auth)

4578 (ITEF-952) VARIATIONAL METHOD FOR THE THREE-BODY RESONANCES. Part 2. Equation for the Resonance Wave Function. Zenkevich, P. R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 23p. INIS.

The resonances in multiparticle systems are rigorously defined through Hilbert-Schmidt eigenvalue $\lambda_n(E)$ of the Hamiltonian. The variational expression for $\lambda_n(E)$ is obtained in the 3-body system, generalizing those found previously for 2-body resonances. Using the explicit expression for the asymptotics of the 3-body resonance wave function for $E > 0$, a system of coupled one-dimensional differential equations is obtained for the components of the wave function of the resonance in the various channels. The position and the width of the resonance are given by the eigenvalue of this system of equations. Moreover the variational principle is formulated in the momentum space for the solution of the homogeneous Faddeev equation. (auth)

4579 (RL-74-39) MUELLER-REGGE ANALYSIS IN THE CENTRAL REGION. Inami, T. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Mar 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

Mueller-Regge analysis of inclusive spectra in the central region for fixed $p_\perp$ is carried out from 12 GeV/c to ISR energies. Analysis of the differences between π^+ and π^- single-particle spectra reveals that both Mueller-Regge energy dependence and factorization are in accord with experiments only in a limited region of moderate value of $p_\perp$, i.e. $p_\perp \gtrsim 0.7$ GeV/c. This suggests that double Regge exchange is a good approximation only for $|t|$ and $|u| \gtrsim 4$ GeV^2. The K/π ratio calculated on the basis of an additive quark-counting picture is also consistent with experiments inside this region. The P-ρ central vertex determined from ISR data turns out to be much smaller than one would obtain from low energy (12 to 24 GeV/c) data. P-M-P exchange contribution $\pi-\pi$ correlations in rapidity thus estimated can explain only a part of observed correlations, which indicates that there should be a large positive contribution from some other effects, such as long range effects and/or Q exchange. Transverse momentum dependence of P-ρ central vertex also determined from ISR data predicts that P-ρ-P exchange contribution to normalized $\pi-\pi$ correlation increases as $p_{1\perp}$ and $P_{2\perp}$ increase. (auth)

4580 (RL-74-46) S-CHANNEL MODELS FOR THE POMERON. Peccei, R. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Mar 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Various difficulties of recent s-channel models for the Pomeron are discussed. It is shown how some of these difficulties can be overcome, where a dynamical mechanism is introduced for generating the triple Pomeron zero and/or absorptive effects are included. (auth)

4581 (TAUP-73-350) ALGEBRA OF STRENGTHS GENERATED BY BILOCAL CURRENTS ACTING ON "CONSTITUENT" STATES. Gomberoff, L.; Horwitz, L. P. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1973. 10p. INIS.

Within the context of a free field model, a unitary transformation is introduced which carries the entire $[U(6) \times U(6)]_{SW}^{currents}$ of the current system, with subgroup $SU(6)_W^{currents}$, into a newly defined $[U(6) \times U(6)]_{SW}^{strong}$, with diagonal subgroup $SU(6)_W^{strong}$, which commutes with the boost in the z-direction. Analysis of strong current-hadron scattering amplitudes in the deep Regge region permits the extraction of the hadron couplings to vector and tensor Regge exchanges as the matrix elements of "strong" charges. (auth)

4582 IS THERE A QUANTIZATION CONDITION FOR THE CLASSICAL PROBLEM OF CHARGE AND POLE? Cohen, H. A. (La Trobe Univ., Melbourne). Found. Phys.; 4: No. 1, 115-120 (Mar 1974).

In elementary derivations of the quantization of azimuthal angular momentum the eigenfunction is determined to be exp(im ϕ), which is "oversensitive" to the rotation $\phi \rightarrow \phi + 2\pi$, unless m is an integer. Recently Kerner examined the classical system of charge and magnetic pole, and expressed Π, a vector constant of motion for the system, in terms of a physical angle ψ, to deduce a remarkable paradox. Kerner pointed out that $\Pi(\psi)$ is "oversensitive" to $\psi \rightarrow \psi + 2\pi$ unless a certain charge quantization condition is met. The explicandum of this paradox highlights the distinction between coordinates in classical and quantum physics. It is shown why the single-valuedness requirement on $\Pi(\psi)$ is devoid of physical significance. One finally led to examine the classical analog of the quantum mechanical argument that demonstrates the quantization of magnetic charge, to show that there is "no hope" of a classical quantization condition. (auth)

4583 EQUATION OF STATE FOR HADRONIC MATTER PRODUCED IN HIGH-ENERGY COLLISIONS. Suhonen, E.; Enkenberg, J. (Department of Theoretical Physics, University of Oulu, Oulu, Finland); Lassila, K.E.; Sohlo, S. Phys. Rev. Lett. 31: No. 26, 1567-1570 (24 Dec 1973).

Conflicting inclusive data from the CERN intersecting storage rings, treated with Landau's original hydrodynamical differential equations for an arbitrary equation of state ($p=H\epsilon$) describing the created hadronic matter fluid, lead to two different physical pictures. A recent Pisa-Stony Brook experiment suggests $p=0.3\epsilon$; $p=\epsilon/3$ implies scale invariance, suggesting we are near an asymptotic region governed by scaling. However, earlier experiments imply that the dynamics may be quite different ($p \simeq 1/2\epsilon$), with viscous hadronic "fluid" being produced. (auth)

4584 SEARCHING FOR CHARM PARTICLES. Snow, G. A. (Univ., Paris). pp 379-390 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The problems involved in the search for massive charmed hadrons are discussed. The importance of the ratio of leptonic to nonleptonic decays for these particles is stressed. Several possible experimental approaches are outlined. (FR)

4585 MELLIN POLES AND STRUCTURE FUNCTIONS. Kozyrski, W. H. (Inst. of Theoretical Physics, Kiev). Lett. Nuovo Cim.; 9: No. 15, 633-635(13 Apr 1974).

It is shown that Mellin transform techniques give the asymptotic behavior of structure functions in the Bjorken region. (LBS)

4586 INCLUSIVE MASS DEPENDENCE OF THE MOMENTUM TRANSFER DISTRIBUTIONS IN THE DUAL RESONANCE MODEL. Vallinkoski, M. K.; Raittio, R. O. (Univ. of Helsinki). Phys. Scr.; 8: No. 6, 225-228(Dec 1973).

The diagrams which contribute in the single Regge limit ($s \rightarrow \infty$, momentum transfer and missing mass fixed and small) in inclusive reactions are calculated using the discontinuity of the dual six-point function. The mass dependnece of the momentum transfer distributions in the low missing mass region is investigated numerically. (auth)

4587 MULTIPLICITY DISTRIBUTION IN THE MULTIPERIPHERAL MODEL. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz., 19: No. 3, 669-681(Mar 1974). (In Russian).

It is shown that in the multiperipheral model the distribution of the number of generated particles differs from the Poisson law due to the kinematical restrictions and because of various types of particles (with different spins) involved in the exchange. A simple model taking all these reasons into account as well as the branching processes (i.e., the processes with production of not one but several multiperipheral chains) is in good agreement with the data. The branchings essentially improve the description of the processes with high multiplicity $n > \langle n \rangle$ and permit one to obtain (in the present day energy region) the KNO scaling. In conclusion a two-parameter formula is derived for the calculation of the topological cross section σ_n by the known mean multiplicity $\langle n \rangle$ and the second correlator f_2. (auth)

4588 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 5, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 83p.

4589 CAUSALITY AND PHYSICAL THEORIES. Conference Held at Detroit, Michigan, May 11-12, 1973. Rolnick, W. B. (ed.). AIP Conference Proceedings, Number 16. New York; American Institute of Physics (1974). 182p. (CONF-730576-).

The conference included 9 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 4590, 4720, 4738, 5250, 5282-5285, and 5335.

4590 HISTORIC VIEWS OF CAUSALITY. Schlegel, R. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 3-21(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

Causality has a central role in physical thought; but there is wide variation, historically, in what is ascribed to particular causal properties such as degree of determinism, past-future asymmetry, and requirement of physical plausibility. Doctrines of causality in Aristotle, Newtonian mechanics, David Hume, Bertrand Russell, and current quantum theory are examined. Although philosophical analysis is a determinant of views of causality, it is apparent that there is also a strong interdependence between what has been established in science and what is accepted as the principle of causality. (auth)

Electromagnetic

Refer also to abstract 5329.

4591 (COO-2232-B-6) ANALYTICITY IN SEVERAL VARIABLES AND PHYSICAL PARAMETRIC SUM RULES. Khuri, N. N.; Auberson, G. (Rockefeller Univ., New York (USA)). 1972. Contract AT(11-1)-2232. 22p. (CONF-721219-4). Dep. NTIS $4.25.

From international conference on mathematical problems of quantum field theory and quantum statistics; Moscow, USSR (12 Dec 1972).

The problem of deriving experimentally testable sum rules that follow rigorously from analyticity in more than one variable and involve only absorptive parts is discussed. The motivation for this search comes from the electroproduction experiments at SLAC. More specifically one would like to determine whether the analyticity properties of the four point function put any restrictions on absorptive parts considered as functions of more than one variable. One of the results is to show how analyticity in the Bros, Epstein, and Glaser domains actually restricts the allowed class of spectral functions in the D. G. S. representation for the Compton amplitudes. Also the same ideas are applied to pion-pion scattering. Starting with an analyticity domain in the two Mandelstam variables which is contained in the domain derived by Martin, a parametric dispersion representation is derived for on-shell amplitudes. This representation is a rigorous consequence of the axioms of local field theory; it displays in a symmetric and explicit way the contributions of all three channels, and it has only physical absorptive parts. It also leads to sum rules involving only the physical absorptive parts as functions of two variables which would give new tests of analyticity if these absorptive parts are ever measured. (auth)

4592 (DESY-74-6) ABSORPTION CORRECTIONS IN A MUELLER-REGGE ANALYSIS OF INCLUSIVE PHOTO- AND ELECTROPRODUCTION. Craigie, N. S.; Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Feb 1974. 36p. Dep. NTIS (US Sales Only) $5.00.

The photon fragmentation region of inclusive pion photo- and electro-production in terms of a helicity dependent Mueller-Regge model, in which cut contributions are taken into account, is discussed. It is shown that the inadequacies of a pure Regge pole expansion can be corrected if certain types of Regge cut contributions are included. The transition from electroproduction to the photoproduction limit is shown to be nonsmooth in the case of charged pions and it is pointed out that the normal triple-Regge mechanisms are unlikely to be important in the deep inelastic region. (auth)

4593 (EFI-27(73)) MACROSCOPIC THEORY OF TRANSITION RADIATION. Garibyan, G. M. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 85p. (In Russian). Dep. NTIS (U. S. Sales Only) $7.25.

A review is given of the contemporary status of the theory of transition radiation. Special attention is given to the formation of radiation in the x-ray frequency range. From the general formulas for transition radiation emitted by ultrarelativistic charged particles in a laminated medium it was shown when it

can be simplified and reduced to a very simple form and when it is necessary to use the general formulas. All calculations were made with a consideration of the absorbing capacity of the material. It was shown that in some cases the absorbing capacity affects not only the yield from the radiation being formed in the laminated medium but also the formation itself of this radiation. Formulas were also obtained for the x-ray transition radiation formed in disordered, nonhomogeneous medium of the foam plastic type. An analysis was made of these formulas, and it was shown when in this medium the radiation will be analogous to radiation formed in stacks of regularly arranged plates. (tr-auth)

4594 (JINR-P4-7520) STABILITY OF SYSTEMS WITH LONG-RANGE POTENTIAL IN THE EXTERNAL FIELD. Temko, S. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Invariant (according to Lyapunov) distributions of particles of composing types are found. With the help of these distributions the lifetime of a particle cluster with the Coulomb interaction in a magnetic field was calculated. (auth)

4595 (LNF-73-68) THEORETICAL ASPECTS OF HIGH ENERGY ELECTRON–POSITRON COLLISIONS. Bramon, A.; Etim, E.; Ferrara, S.; Greco, M.; Grillo, A. F.; Rossi, G. C.; Srivastava, Y. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 21 Dec 1973. 29p. Dep. NTIS (U. S. Sales Only) $4.50.

Theoretical investigation carried out at Frascati on high-energy e^+e^- collisions is reported. (auth)

4596 (MATSCIENCE-76, pp 221-232) SPIN PRECESSION OF A CHARGED PARTICLE IN A MAGNETIC FIELD INCLUDING THE EFFECTS OF GENERAL RELATIVITY. Prasanna, A. R. (Inst. of Mathematical Sciences, Madras); Kumar, N. May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The equations of spin precession for a charged particle in a magnetic field were obtained in the framework of general relativity. These equations are a generalization of the well known Bargmann-Michel-Telegdi equations of special relativity for a spinning particle. In the limit when the particle has no magnetic-moment (g = o) these equations give a generalization of the Thomas precession for curved space-time. (auth)

4597 (RHEL-72-1(Vol. 1), pp 87-126) THEORY OF LEPTON–HADRON INTERACTIONS. Llewellyn Smith, C. H. (Stanford Linear Accelerator Center, CA). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The topics discussed are partons, the light cone, etc., tests of hadron models in exclusive and inclusive electroproduction, and unified unrenormalizable theories of weak and electromagnetic interactions. (JFP)

4598 (WIS-73-4-Ph) PHOTON INITIATED REACTIONS IN THE RESONANCE REGION. Collins, P. V.; Kowalski, H.; Rubinstein, H. R.; Roemer, H. (Weizmann Inst. of Science, Rehovoth (Israel)). 1973. 14p. INIS.

A consistent picture of two-body photon-initiated reactions is achieved by implementing a resonance model in the s-channel compatible with duality and gauge invariance. Large real parts generated by contact terms to achieve gauge invariance appear in a well-defined pattern. Their size explains hitherto puzzling reactions like $\gamma N \to \rho N$, $\gamma N \to \rho\Delta$ and $\gamma N \to \omega\Delta$, near their thresholds. (3 figures) (INIS)

4599 COMPTON EFFECT ON VECTOR MESONS. Fedorov, F. I.; Engel'mann, Z. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 55-62(1974). (In Russian).

A general expression was obtained for the matrix elements of the Compton scattering process on particles with spin 1 suitable for random pulses and energies of interacting particles, random polarization of both photons and during any projection of the spin of the incident and scattered mesons in random directions. A method of projected operators and the covariant spin theory, based on the complex vector parametrization of the Lorentz groups, was used during the calculation. The particular case of forward scattering was examined in detail. (tr-auth)

4600 COULOMB SCATTERING OF POLARIZED PARTICLES WITH SPIN 1. Bedritskii, A. I.; Rabinovich, I. L.; Ivanovskaya, A. B.; Gelyasin, A. E. (Vitebsk State Pedagogical Inst., USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 113-115(1974). (In Russian).

The differential effective cross section of the elastic scattering of polarized particles with spin 1 by heavy Coulomb centers was found in the first approximation of the perturbation theory. After summation up to the final polarization and averaging over the initial polarization the results were compared with the cross sections obtained in previous studies by others. (tr-auth)

4601 TRANSITIONS IN TWO-LEVEL SYSTEMS AT DIFFUSION MODULATED ISOTROPIC INTERACTIONS. Aleksandrov, I. V.; Karamyan, L. G. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 4, 270-278(1973). (In Russian).

Nonadiabatic transition probability in two-level system at the diffusive motion of isotropically interacting particles in an external magnetic field is calculated. The energy difference between the levels $\hbar\omega$ (r(t)) is a random function of time due to the diffusive motion of particles. Values of the nonadiabatic transition probability per unit time were obtained by perturbation theory, where nonsecular part of interaction was taken as a perturbation. (auth)

4602 TRANSITION RADIATION IN AN IRREGULAR NONUNIFORM MEDIUM. Garibyan, G. M.; Gevorgyan, L. A.; Yang, C. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 4, 248-251(1973). (In Russian).

A formula for the spectral intensity of x-ray transition radiation formed in an irregular nonuniform medium of a styrofoam type is derived. This formula is averaged over the wall and pore thicknesses. It is shown that if the ratio of mean-square deviation of the wall thickness to the square of the formation zone in the medium plus the analogous ratio for vacuum layers is much smaller than the ratio of mean period of the irregular medium to the formation zone in vacuum, the radiation of the irregular medium will but slightly differ from the radiation of a regular lamination with a corresponding number of plates. (auth)

4603 RELATION BETWEEN VARIOUS INCLUSIVE PROCESSES IN QUANTUM ELECTRODYNAMICS. Kuraev, E. A.; Lipatov, L. N.; Strikman, M. I. (Leningrad Inst. of Nuclear Physics). Zh. Eksp. Teor. Fiz.; 66: No. 3, 838-848(Mar 1974). (In Russian).

The relation between the inclusive spectra $f(x,k_\perp) = d\sigma/\partial x \partial^2 k_\perp$ is considered. For the conjugated reactions $a + b \to c$ + anything and $a + \bar{c} \to \bar{b}$ + anything, calculated by means of the inelastic Born amplitudes, the relation $f_{b\to c}(x, k_\perp, s) = -x^{-1} f_{\bar{c}\to\bar{b}}(1/x, k_\perp x, -xs)$ is obtained. (auth)

4604 GENERALIZED VECTOR DOMINANCE. Schildknecht, D. (Deutsches Elektronen-Synchrotron, Hamburg). pp 181-234 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The predictions of the vector meson dominance model are compared with photoproduction and e^+e^- annihilation data. This model is generalized in order to interpret deep inelastic electron scattering data. (FR)

4605 INELASTIC ELECTRON–POSITRON SCATTERING. Gourdin, M. (Paris Univ., Orsay, France). pp 73-78 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

Two photon exchange in $e^+e^- \to e^+e^-$ + gamma is studied without introducing the quasi-real photon approximation. (FR)

4606 RESONANCES IN HIGH ENERGY COLLIDING LEPTON BEAMS. Rosner, J. L. (CERN, Geneva). pp 29-40 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

Some e^+e^- collision experiments are suggested enabling symmetries which are stronger than SU(3) to be distinguished. The experiments suggested are similar to those involved in studies of the polarization of the ω meson in $B \to \omega\pi$ decay. (FR)

4607 THEORETICAL IDEAS ABOUT ONE PARTICLE INCLUSIVE REACTIONS INDUCED BY LEPTONS. Altarelli, G. (Univ., Rome). pp 101-123 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The principle theoretical ideas concerning $l + N \to l' + h$ + all and $e^+e^- \to h$ + all type reactions (where l is a lepton and h is a hadron) are reviewed. (FR)

4608 YANG-MILLS MODELS OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Iliopoulos, J. (Paris Univ., Orsay,

France). pp 305-327 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

A brief review of the unified renormalizable models for weak and electromagnetic interactions is presented. (FR)

4609 SUGGESTION CONCERNING INCLUSIVE STUDIES IN e^+e^- REACTIONS. Bernardini, C. (Univ., Rome). pp 23-27 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

Inclusive reactions with e^+e^- storage rings are studied. (FR)

4610 LIGHT CONE PHYSICS AND THE PARTON MODEL. Kuti, J. (Eotvos Lorand Tudomanyegyetem, Budapest). pp 235-268 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

General aspects of the physics of the light cone and the quark parton model are discussed for the case of deep inelastic lepton-nucleon scattering. The importance of obtaining neutrino and antineutrino beams is clearly seen together with the need for determining the various inelastic electron-nucleon scattering spin amplitudes. (FR)

4611 STRUCTURES IN e^+e^- ANNIHILATION: HIGHER VECTOR MESONS OR INELASTIC EFFECTS. Renard, F. M. (Univ., Montpellier, France). pp 79-100 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The structures observed between 1 and 2 GeV in the pion form factor and the annihilation of e^+e^- into many hadrons were analyzed in two different ways: by postulating the existence of higher vector mesons: $\rho'(1.3)$; $\rho''(1.65)$; by using a new propagator for ρ which explains simply the width energy dependence and the strong inelasticity. (FR)

4612 MASSES OF LEPTONS AND BARYONS. Becker, F. (Univ., Strasbourg). Lett. Nuovo Cim.; 9: No. 16, 637-640 (20 Apr 1974).

Some simple analogies between the formulas giving the masses of leptons and baryons are exhibited from heuristic arguments. It is postulated that the whole mass of a particle is proportional to the strength of the strongest fundamental interaction produced by this particle. Calculated values for the masses of baryons and leptons are given in terms of the fundamental interaction coupling constants. (LBS)

4613 POSSIBLE ROLE OF TWO-PHOTON PROCESSES IN HIGH ENERGY COLLIDING-BEAM EXPERIMENTS. Greco, M. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 9: No. 16, 645-649 (20 Apr 1974).

The role of the two-photon mechanism of hadron production in e^+e^- colliding beam experiments is examined. The cross sections for the processes $\gamma\gamma \to \pi^+\rho^-$ and $\gamma\gamma \to \omega\omega$ are calculated under the hypothesis of single-pion exchange, and the contributions to the process $e\bar{e} \to e\bar{e}$ + hadrons are estimated. (LBS)

4614 ASYMPTOTIC BEHAVIOR AND THE CABIBBO-RADICATI SUM RULE. Aubrecht II, G.J.; Wada, W.W. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Ann. Phys. (N.Y.) 78: No. 2, 376-390 (June 1973).

The Cabibbo-Radicati sum rule has previously been explicitly evaluated (in terms of resonance saturation) to an energy ~ 1.7 GeV. An investigation of higher contributions indicates that the sum rule is reasonably well satisfied. (auth)

4615 DEEP ELECTROPRODUCTION AND DEEP ELECTRON-POSITRON ANNIHILATION. Gatto, R. (Istituto di Fisica dell'Università, Roma, Italy); Menotti, P.; Vendramin, I. Ann. Phys. (N.Y.) 79: No. 1, 1-33 (July 1973).

The problem of continuation of the scaling functions for deep inelastic electron scattering into deep inelastic annihilation is discussed. Dynamical models are produced for which analytic continuation connects the two scaling functions and the general conditions are discussed. The dynamical characterization of those situations for which the analytic continuation rule is invalid is also given. The study also illustrates the structure of the singularities of the scaling functions in the ω-plane. Models studied include ladder diagrams and particular diagrams with unstable particles propagated. In the latter case cuts generally appear in the scaling functions in the kinematical region for annihilation. (auth)

4616 DUAL PARTON MODEL AND THE PHOTOPRODUCTION OF PSEUDOSCALAR AND VECTOR MESONS IN THE HIGH ENERGY REGION. Bandyopadhyay, P.; Raychaudhuri, P. (Indian Statistical Institute, Calcutta-35, India); De, S.S. Ann. Phys. (N.Y.) 80: No. 1, 142-156 (Sept 1973).

On the basis of the dynamical dual model of strong interactions followed from the parton model of hadrons as discussed in an earlier paper, we study here the photo-production of pseudoscalar and vector mesons in the high energy region. To incorporate the concept of duality, it is taken that any two spin 1/2 pointlike constituents (partons) can form a π-meson cluster in the structure of a nucleon and the basic interaction involved in MB scattering is the interaction of the incident meson with the π meson in the structure of the nucleon. In this scheme, the amplitudes for the photoproduction of mesons such as $\gamma N \to N\pi$, $\gamma N \to N\rho$, and $\gamma N \to N\omega$ in the high energy region can be related with the amplitudes for the process $\gamma\pi \to \pi\pi$, $\gamma\pi \to \pi\rho$, and $\gamma\pi \to \pi\omega$, respectively. To calculate the amplitudes for the relevant process we also consider a factor corresponding to the structural rearrangement of partons involved in duality diagrams. To obtain the cross sections, we take into account the photon-vector meson analogy, though the naive form of the vector dominance model (VDM) has not been considered here. From a knowledge of the coupling constants ${}^{\gamma}\rho^2/4\pi$, ${}^{\gamma}\omega^2/\phi\pi$, ${}^{\omega}\rho\pi/4\pi$, and ${}^{\omega}\rho\pi\pi/4\pi$ we obtain the differential cross sections which are in excellent agreement with experimental results. Also we obtain a good fit for the scattering process $\gamma N \to N\pi$ at backward angles. For the vector meson production processes, we have contributions from the diffraction mechanism also apart from the amplitudes considered here. In the region where the contribution from the diffraction part is negligible, we obtain the relation $(d\sigma/dt)(\gamma p \to pp^0)/(d\sigma/dt)(\gamma p \to p\omega^0) = {}^{\gamma}\omega^2/4\pi/{}^{\gamma}\rho^2/4\pi \simeq 7$ which is in nice agreement with experiments. Finally, it is shown that, though the vector meson dominance is not considered here, the universality of the vector meson coupling with hadrons follows directly from the present model. (auth)

4617 PROTON-NEUTRON MASS DIFFERENCE IN GAUGE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Fayyazuddin (Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England); Riazuddin. Ann. Phys. (N.Y.) 80: No. 1, 189-211 (Sept 1973).

The question of cancellation of logarithmic divergence appearing in the proton-neutron mass difference is studied in gauge theories of weak and electromagnetic interactions. In particular, we study the proton-neutron mass difference in three kinds of gauge models. It is found that the contribution from weak hadronic currents in two of the models cancels the logarithmic divergence arising from purely electromagnetic interaction, but as pointed out in the text these two models suffer from some other defects. In one of the models such a cancellation is not possible although the model is otherwise attractive. In this latter case, a mass renormalization counter term exists to absorb the infinity in the mass difference leaving the mass difference essentially a free parameter. (auth)

4618 NATURAL BASIS OF WAVE FUNCTIONS FOR PARTICLES IN THE FIELD OF A PLANE WAVE. Fedorov, F. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 18: No. 1, 17-20(Jan 1974). (In Russian).

A method is presented for the exact solution of relativistic wave equations of the 1st order for charged particles with different spins in the field of a plane electromagnetic wave. Being Lorentz invariant the method does not use matrix algebra of Γ^k equations so that its application to particles with high spins is made easier. In this case the Γ^k matrices are determined by indicating their mode of action on the wave function which is assigned on a natural basis associated with constant 4-vectors characteristic for a given problem: of the particle momentum p, of the wave vector k and of the vector-potential a. The effectiveness of the method is illustrated by its use to solve completely the indicated problem for particles with spins 0, 1 and ½ (including the case of the Pauli interaction). For particles with spins ³/₂ and 2 a method is indicated for obtaining corresponding systems of equations. (tr-auth)

4619 BINARY LOGARITHMIC ASYMPTOTICS OF THE $e^-e^+ \to e^-e^+\gamma$ PROCESSES. Gadzhiev, S. A.; Gotlib, I. A. Dokl. Akad. Nauk Azerb. SSR; 29: No. 6, 18-22(In Russian).

The calculation of the $e^-e^+ \to e^-e^+\gamma$ process cross section at high energies and low transfer momenta in the binary logarithmic approximation. An account is taken of the ladder-type diagrams as well as of the diagrams where the radiation of the real photon is embraced by the virtual photons of decelerating nature. (auth)

4620 NEW EQUATION OF MOTION FOR A RADIATING CHARGED PARTICLE. Bonnor, W. B. (Queen Elizabeth Coll., London). Proc. Roy. Soc. (London), Ser. A; 337: No. 1611, 591-598(9 Apr 1974).

A new equation of motion for a classical radiating point-charge is proposed. The radiated energy is supplied by a reduction in

proper-mass of the particle. Unlike the Lorentz-Dirac equation, the equation proposed is second order: it gives physically reasonable predictions, and in particular has no runaway solutions and no pre-acceleration. (auth)

4621 ENERGY DEPENDENCE OF SINGLE PARTICLE SPECTRA IN e^+e^- ANNIHILATION. Engels, J.; Satz, H.; Schilling, K. (Univ., Bielefeld, Ger.). Phys. Lett.; 49B: No. 2, 171-174(1 Apr 1974).

Explicit predictions of the statistical bootstrap model are presented for inclusive single particle spectra in e^+e^- annihilation. The distribution $(\omega/\sigma_{tot}) \cdot E)(d\sigma/p^2dp)$ is found to become, for $E \geq 3$ GeV, a function only of the secondary energy ω, independent of the incident e^+e^- energy E. (auth)

4622 LEGENDRE POLYNOMIAL EXPANSION OF THE KLEIN-NISHINA DIFFERENTIAL CROSS SECTION. Weise, K. E.; Foderaro, A. (Pennsylvania State Univ., University Park). Nucl. Sci. Eng.; 54: No. 1, 85-93(May 1974).

Expansion coefficients for the Klein-Nishina differential cross section are presented for 17 energies in the range 0.1 to 12.0 MeV. The maximum order of these coefficients for the higher photon energies is L = 35. An interpolation procedure for the generation of expansion coefficients at additional energies is also presented. A study is made of the errors introduced in the Klein-Nishina cross section when finite-order polynomial approximations are used. The error investigation includes average-weighted percent error, local percent error at $\theta = 0$, forward-weighted percent error, and angular regions in which the expanded differential cross section is negative. The average-weighted percent error is found to be indicative of all other errors. Results indicate that cross-section errors at various energies and orders of expansion may be readily predicted. Several methods are introduced for determining a suitable degree of expansion to ensure accuracy of the finite-order expansion of the Klein-Nishina differential cross section. (4 figures, 5 tables) (auth)

4623 THREE-QUARTET MODELS AND DEEP INELASTIC SCATTERING. Koca, M. (International Centre for Theoretical Physics, Trieste, Italy). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1364-1380(Oct 1973).

The integrally charged three-quartet model of quarks which was suggested for the cancellation of the Adler anomalies in the framework of the Weinberg-Salam model is developed incorporating the charged and neutral weak currents with the model. Two models are constructed, one of which is the SU(4) generalization of the Cabibbo-Maiani-Preparata model proposed for SU(3) and the other made with certain assumptions on the weak currents. The predictions of these models for the deep inelastic form factors are calculated with the use of light-cone algebra technique. The main results, including those of the colored version of the fractionally charged Glashow-Iliopoulos-Maiani model, are listed. It is noted that the predictions of all the models for $\int_0^1 (F_1^{ep} + F_2^{en})d\xi$ are within the range of the present experimental limits. The other results obtained are discussed. (auth)

4624 TWO-PARTICLE DISTRIBUTIONS AND CORRELATIONS IN e^+e^- ANNIHILATION. Scott, D. M. (Cambridge Univ., Eng.). Nuovo Cim., 21A: No. 1, 1-10(1 May 1974).

Deep inelastic e^+e^- annihilation with two final-state detected particles is considered. Relations between the distributions for different particles are derived in the quark-parton model. Possible two-particle correlations are discussed in terms of both the parton model, and a particular fragmentationlike decay of timelike virtual partons. (auth)

4625 BOUNDS AND HIGH ENERGY BEHAVIOR OF THE PION FORM FACTOR FROM THE MODULUS REPRESENTATION. Ecker, G.; Schwela, D. (Univ., Vienna). Lett. Nuovo Cim.; 9: No. 15, 587-595(13 Apr 1974).

The upper and lower bounds on the pion form factor are investigated in view of many new data both in the timelike and spacelike regions. The asymptotic behavior of the form factor is examined for two Breit-Wigner-type resonance fits to the data. (LBS)

4626 GENERAL OUTLOOK ON SCALING PHENOMENA. Amati, D.; Fubini, S. (CERN, Geneva). Phys. Lett., 49B: No. 3, 293-296(15 Apr 1974).

A general dynamical criterion is proposed in order to classify the different kinds of asymptotic scaling behaviors. On this basis an attempt is made to understand and compare the different trends in e^+e^- annihilation and deep inelastic lepton scattering. (auth)

4627 VECTOR MESON WITH QUADRUPOLE ELECTRIC MOMENT. Vlasov, P. A. (Dnepropetrovsk State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 179-185(Feb 1974). (In Russian).

An electric quadrupole moment of a vector meson is described by introducing additional terms containing the derivatives $\partial_\mu F_{\nu\lambda}$ to the Kemmer equation. The choice of the corresponding interaction Lagrangian is discussed. After eliminating the redundant components of the wave function from the Kemmer equation, the Hamiltonian form of the wave equation is obtained. The theory is applied to the motion of the vector meson with a quadrupole moment in a central field. The nonrelativistic approximation and connection with Proca formalism are also considered. (auth)

4628 ASYMPTOTIC PROPERTIES OF ELECTROMAGNETIC FORM FACTORS OF EXCITING NUCLEON RESONANCES. Gakh, G. I.; Kulish, Yu. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 216-220(Feb 1974). (In Russian).

Asymptotic behavior was studied for transversal and longitudinal electromagnetic form factors of exciting nucleon resonances. The sensitivity of the asymptotic behavior of these form factors to properties of different models is examined. (auth)

4629 ELECTRON IN A HOMOGENEOUS ELECTROMAGNETIC FIELD AND THE FIELD OF ARBITRARY POLARIZED PLANE ELECTROMAGNETIC WAVE. Borgardt, A. A.; Karpenko, D. Ya. (Donets Physical-Technical Inst., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 227-236(Feb 1974). (In Russian).

An exact solution is obtained for the classical problem on the motion of a charged relativistic particle in a constant homogeneous electromagnetic field and field of arbitrary polarized plane electromagnetic wave providing there exists a phase integral. An exact solution of the Klein-Gordon and Dirac equations is obtained for a simpler case, the magnetic (or electric) field in the direction of wave propagation. In the limit when the wave field is omitted the solution is a wave packet nonspreading with a change in the proper time representing in that way the relativistic coherent state. In this connection the possibility of reducing the Klein-Gordon equation to the formally nonrelativistic Schrödinger equation (but in the proper time) is demonstrated. (auth)

4630 PREDICTIONS OF THE HYDRODYNAMICAL MODEL FOR e^+e^- ANNIHILATION INTO HADRONS. Baacke, J. (Univ., Dortmund, Ger.). Phys. Lett., 49B: No. 3, 297-300(15 Apr 1974).

The inclusive one-particle distribution for hadrons produced in e^+e^- annihilation is evaluated in the hydrodynamical model, thereby improving previous rough estimates. The general features of the x-distributions are an overall increase as $s^{1/4}$ and a concentration towards $x = 0$ corresponding to $\langle x \rangle \sim W^{-1}$. (auth)

4631 EIGHTH MORIOND MEETING: CONCLUSIONS. Rosner, J. L. (CERN, Geneva). pp 391-395 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From 8th Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

Emphasis is given to the unification of the weak and electromagnetic interactions, and the study of hadron structure using these interactions. (FR)

4632 ZEROS OF THE PION FORM FACTOR. Cronstroem, C. (Univ. of Helsinki). Phys. Lett., 49B: No. 3, 283-285(15 Apr 1974).

A sum-rule is derived for the modulus of the pion form factor in the time-like region, by means of which one can test the existence of complex zeroes in the formfactor. The available data indicates that such zeroes exist. (auth)

4633 FINITE DISPERSION RELATION APPROACH TO $\eta \to \pi^+\pi^-\gamma$ DECAY. Bramon, A.; Greco, M. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 9: No. 15, 583-586(13 Apr 1974).

A theoretical approach, based on the use of finite dispersion relations, is presented that allows a rather self-consistent determination of $\Gamma(\eta \to \gamma\gamma)$ from the $\eta \to \pi^+\pi^-\gamma$ decay rate. The result implies $\Gamma(\eta \to \gamma\gamma) \simeq (310 \pm 120)$ eV. (LBS)

4634 CORRECTIONS TO THE IMPULSE APPROXIMATION FOR PION PHOTOPRODUCTION ON DEUTERONS IN THE $\Delta(1236)$ RESONANCE REGION. Aznauryan, I. G. Yadern. Fiz.; 19: No. 3, 640-651(Mar 1974). (In Russian).

In view of the present discrepance between the data on the direct and inverse reactions $\gamma n \rightleftharpoons p\pi^-$ in the $\Delta(1236)$ resonance region the corrections are considered to the impulse approximation for the pion photoproduction on deuterons. It is shown that the corrections due to the single rescattering in the final state do not remove the discrepancy. The effect of the corrections is considered in determining the value of the isotensor electromagnetic hadronic current by means of the data on $\gamma n \to n\pi^0$ obtained from the experiments on deuterons. (auth)

4635 PION ELECTROMAGNETIC FORM FACTOR. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 652-659(Mar 1974). (In Russian).

The electromagnetic form factor of the massive τ meson is calculated using the superpropagator method in the theory of a chiral kind. The obtained values of the pion radius $\sqrt{\langle r^2 \rangle} \simeq 0.65$ F, of the scattering length $a| = 0.031\ m_\pi^{-3}$ and the absolute value of the form factor in the threshold energy region are in good agreement with the experimental data. (auth)

4636 NON-ABELIAN COMPTON EFFECT ON SPIN-$\frac{3}{2}$ TARGETS. Ragusa, S. (Sao Paulo Univ., Sao Carlos, Brazil). Rev. Brasil. Fis.; 3: No. 2, 277-290(Oct 1973).

The scattering of isovector photons on spin-$\frac{3}{2}$ targets is studied in detail up to second order to the frequency of the incident photon. Using Singh's lemma, new second order low-energy theorems related to isospin-symmetric amplitude are obtained. (auth)

4637 RADIATIVE EFFECTS IN THE INCLUSIVE e^+e^- ANNIHILATION INTO HADRONS. Matinyan, S. G.; Pirogov, Yu. F.; Ter-Isaakyan, N. L.; Shakhnazaryan, Yu. G. (Inst. of Physics, Erevan). Yadern. Fiz.; 19: No. 3, 660-668(Mar 1974). (In Russian).

It is shown that at high energies the inclusive e^+e^- annihilation into hadrons with a hard photon emission by a lepton is essential and dominates compared to the corresponding process without a photon emission. The cross section of the process under consideration is calculated at the limited transverse momenta of the hadron. The result is represented as integrals over the scaling variable ω of the structure functions $\bar{F}_i(\omega,\nu)$ describing the e^+e^- annihilation into hadrons. (auth)

4638 APPLICATION OF K-MATRIX CMSR's TO SINGLE CHARGED PION PHOTOPRODUCTION. Logothetidou, A. (Univ., Hamburg). Nucl. Phys.; B69: No. 3, 593-617(1974).

The background terms, required in addition to Regge poles with some definite properties, in order to describe the high energy behavior of the t-channel single pion photoproduction amplitudes $F_i^{(-)}(\nu,t)$, $i = 1, \ldots, 4$, are investigated in the framework of a reggeized K-matrix model. To this end continuous moment sum rules (CMSR's) are applied, not to the full amplitudes, but just to the two-particle K-matrix amplitudes assumed to show pure Regge pole asymptotic behavior. The K-matrix amplitudes are defined by taking into account in the Heitler equation the elastic (πN) intermediate state alone. Such a definition corresponds to a weak-cut model with only final-state interactions included. It turns out that strong background contributions are still present on the high energy side of the K-matrix CMSR's. The Regge cut contributions generated within our formalism are found to be too weak to account for the background terms in the full amplitudes. This is presumably to a great extent due to the neglect of the (ρN) diffraction-dissociation intermediate state in the definition of the K-matrix amplitudes. (auth)

4639 CMSR's FOR SINGLE CHARGED PION PHOTOPRODUCTION AMPLITUDES AND THE ROLE OF THE GAUGE INVARIANT BORN TERMS. Logothetidou, A. (Univ., Hamburg). Nucl. Phys.; B69: No. 3, 562-592(1974).

Continuous moment sum rules (CMSR's) for the t-channel single pion photoproduction amplitudes $F_i^{(-)}(\nu,t)$, $i = 1, \ldots, 4$, are considered in great detail. Information about the high energy behavior of the amplitudes is extracted from low energy data in terms of an effective Regge pole picture which in most cases turns out to strongly violate certain reasonable postulates about the behavior of pure Regge poles (idealized Regge pole picture). It is asked whether the deviation of the effective Regge pole picture from the idealized one can be described in terms of fixed poles at $J = 0$ arising from certain parts of the gauge invariant Born term contributions to the amplitudes. Such a description does work for small $|t|$ in case of the amplitudes $F_i^{(-)}(\nu,t)$, $i = 2, 3$, but, as $|t|$ increases, further contributions also become important. Investigation of CMSR's for amplitudes from which appropriate parts of the Born terms have been separated out, leads to a definite finite energy sum rule (FESR) duality scheme where parts of the Born terms "build up" the idealized Regge poles themselves, while other parts give rise to additional contributions on the high energy side of the CMSR's. (auth)

4640 NUCLEON AS A BOUND STATE OF THREE QUARKS AND DEEP INELASTIC PHENOMENA. Altarelli, G. (Univ., Rome); Cabibbo, N.; Maiani, L.; Petronzio, R. Nucl. Phys.; B69: No. 3, 531-556(1974).

A description of deep inelastic ep and νp scattering is presented. The nucleon is described as a bound state of three quarks in the $p \to \infty$ frame. The constituent quarks have themselves a structure suggested by the quark gluon parton model. A good fit to existing data is thus obtained. This fit requires that $SU(6)_w \otimes O(3)$ is broken at $p \to \infty$ by small configuration mixing. (auth)

4641 HIGH ENERGY PION PHOTOPRODUCTION AMPLITUDES FROM FIXED-T DISPERSION RELATIONS AND DUALITY. Barbour, I. M. (CERN, Geneva); Moorhouse, R. G. Nucl. Phys.; B69: No. 3, 637-656(1974).

Contributions to the high energy imaginary parts of the charged and neutral pion photoproduction amplitudes from degenerate ρ and A_2 exchanges and ω and B exchanges are parametrized similarly to the dual absorptive model. These contributions together with the imaginary parts of the amplitudes found at low energies from partial-wave analyses are then used to evaluate the high energy real parts of the photoproduction amplitudes from fixed-t dispersion relations. A fit is made to data on pion photoproduction at 3.4 and 16 GeV incident photon energies, for momentum transfers up to $-1(\mathrm{GeV}/c)^2$. It is shown that much of the data is reproduced both qualitatively and quantitatively by our model. The high energy imaginary parts of the photoproduction amplitudes given by the fit are shown to be in accord with their average low energy behaviour. (auth)

4642 DYNAMICS OF QUANTUM CORRELATIONS. Kueber, O.; Zeh, H. D. (Univ., Heidelberg). Ann. Phys. (N. Y.); 76: No. 2, 405-418(Apr 1973).

The density matrix describing the state of a subsystem of a physical system whose time dependence is assumed to follow a Schrödinger equation does not itself obey a von Neumann equation. The behavior of the eigenvalues and eigenfunctions of this density matrix is studied. An expression for the rate at which initially separating systems are de-separated is derived in perturbation theory. Indications are given that coherent photon states are more stable in the presence of charged particles than photon number eigenstates. The possible dynamical origin of superselection is discussed. A simple model is solved analytically. (auth)

4643 CHERENKOV RADIATION IN BIAXIAL CRYSTALS. I. Datta Majumdar, S.; Pal. R. (Indian Inst. of Tech., Kharagpur). Ann. Phys. (N. Y.); 76: No. 2, 419-427(Apr 1973).

The radiation emitted by a uniformly moving point charge in a biaxial crystal is studied by a new method. Fourier integrals for the field are set up for the general case without imposing any restriction on the dielectric and magnetic properties of the crystal or on the direction of motion of the charge. In the case of motion along a principal dielectric axis the integrals are evaluated exactly and closed expressions for the radiated energy are obtained. For radiation of either kind these expressions involve Heuman's Lambda function and the complete elliptic integral of the first kind. (auth)

4644 CHERENKOV RADIATION IN BIAXIAL CRYSTALS. II. Datta Majumdar, S. (Indian Inst. of Tech., Kharagpur). Ann. Phys. (N. Y.); 76: No. 2, 428-436(Apr 1973).

By a series of transformations the integral for the radiated energy in the general case is brought into a form which facilitates its evaluation. Two results follow from this. First, it is seen that a generalized uniaxiality condition can be formulated even when the electric and the magnetic anisotropy axes do not coincide. Secondly, a theorem is established which enables one to deduce the results for double anisotropy from those for anisotropy in ϵ only by means of certain simple substitution. (auth)

Weak

4645 (CONF-720724-P2, pp 160-169) SEARCH FOR SHORT-LIVED PARTICLES AND DETECTION OF ONE HAVING $\tau \sim 10^{-14}$ SEC. Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

No particles are known with lifetimes in the range from 10^{-10} to 10^{-17} seconds, and it has been suggested that there may be none. Calculations concerning the prospects of the search for and the investigation of the production of the χ particle with lifetime about 10^{-14} s are presented. The expected mass of this particle (~2 GeV) would allow its production with existing accelerators. It is expected to decay into a π^0 and p or π. Its average range and decay characteristics are discussed, along with the background anticipated in its production. Estimates on the production cross section are given. (2 tables) (RWR)

4646 (COO-2232-B-43) $2S_{\frac{1}{2}} \to 1S_{\frac{1}{2}} + 1$ PHOTON DECAY OF MUONIC ATOMS AND PARITY VIOLATING NEUTRAL CURRENT INTERACTIONS. Feinberg, G.; Chen, M. Y. (Rockefeller Univ., New York (USA). Dept. of Physics; Columbia Univ., New York (USA). Dept. of Physics). 1974. Contract AT(11-1)-2232. 46p. Dep. NTIS $5.50.

The decay $2S_{\frac{1}{2}} \to 1S_{\frac{1}{2}} + 1$ photon, in muonic atoms, is considered as a probe of parity violating interactions between muons and nucleons. It is shown that a parity violating interaction, arising

from neutral currents, with a strength comparable to the Fermi interaction, would induce a small admixture of $2P_{\frac{1}{2}}$ state into the $2S_{\frac{1}{2}}$ state of muonic atoms, with a magnitude of approximately 10^{-4}. Such an admixture would allow the $2S_{\frac{1}{2}}$ to decay to $1S_{\frac{1}{2}} + 1$ photon by an E1 transition, as well as by the known M1 transition. Since the E1 matrix element is much larger than the M1 matrix element, the small state admixture will be enhanced in the decay matrix element. In particular, the circular polarization of the emitted photon, or the photon angular asymmetry relative to the muon polarization, would be of order 10^{-4} in nuclei near Z = 30, and so are perhaps measurable. The branching ratio of the $2S_{\frac{1}{2}} - 1S_{\frac{1}{2}} + 1$ photon decay to other transitions from the $2S_{\frac{1}{2}}$ state is considered, and found to be around 10^{-3} in nuclei of interest. Similar considerations are given for the $2S_{\frac{1}{2}}$ $1S_{\frac{1}{2}} + 1$ photon decay of electron hydrogenic ions, where it is found that the circular polarizations are much smaller, but the branching ratios can be substantially larger. (auth)

4647 (JAERI-M-5381) UTILITY CODE SYSTEM FOR JAERI-FAST 70-GROUP SET: J-FAST-70U. Hasegawa, A.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 60p. (In Japanese). NTIS (US Sales Only).

J-FAST-70U, a utility code system for JAERI-Fast 70-group constants was developed. The code system was constructed from JFUSER, LTFR70, LTFCOR, LTFDMP, JFCOMB programs and a JAERI-Fast 70-group set library tape. JFUSER covers following functions, such as tabulation of nuclear cross section group constants in the JAERI-Fast 70-group library tape, print and punch and graph plotting of these data, and production of coarse group constants of less than 70-group. Producing of unformatted library tape for EXPANDA-70D code will be done by LTFR70, and that library will be retrieved by LTFCOR. The retrieved material is all data in that library. Then the unformatted library tape contents will be tabulated by LTFDMP code. As above mentioned this J-FAST-70U system will be served as utility program for JAERI-Fast 70-group constants and also will be served as an auxiliary routine for EXPANDA-70D code. (auth)

4648 (MATSCIENCE-76, pp 10-27) PHOTON–NEUTRINO WEAK COUPLING, DEGENERATE SEA OF NEUTRINOS, AND GRAVITATIONAL PHENOMENA. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

It is shown here that gravitation can be interpreted as an electromagnetic effect if it is considered that there exists a sea of degenerate neutrinos and antineutrinos in the universe, the neutrino energy density being related with the matter density and that photons can interact weakly with neutrinos. It is suggested that degenerate neutrinos and antineutrinos in the universe can be considered to be held together in an equilibrium position by the binding force generated by the photon–neutrino weak coupling. This may then give rise to the polarization effect, similar to the polarization effect observed in any dielectric medium. Again, from the view-point that the neutrino energy density is related to the matter density, the distribution of degenerate neutrinos and antineutrinos is supposed to be dependent on the distribution of matter. This distribution pattern may then lead to a spatial variation of the polarizability such that the refractive index becomes higher in the vicinity of a massive body. These aspects give rise to gravitational phenomena, and gravitation in this sense is considered to be an electromagnetic effect. The role of the principle of equivalence and Mach's principle in this framework were also discussed. Finally, some remarks about the existence of gravitational waves and the possibility of the variation of the gravitational constant G with time were made. (auth)

4649 FLUX-INDEPENDENT TEST OF MODELS FOR DEEP INELASTIC NEUTRINO REACTIONS. Bajpai, R. P.; Mukherjee, S. (Himachal Pradesh Univ., Simla, India). Lett. Nuovo Cim.; 9: No. 16, 663-666(20 Apr 1974).

A simple method of testing various theoretical models for the lepton-hadron processes by flux-independent measurements only is presented. The results are applied to two models; the structure functions calculated in these two models are given. (LBS)

4650 PRELIMINARY RESULTS ON ANTINEUTRINO AND NEUTRINO TOTAL CROSS-SECTIONS. Haguenauer, M. (Ecole Polytechnique, Paris). pp 269-280 of Proceedings of the Eight Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The total neutrino and antineutrino cross sections were measured together with their ratio. The results are compatible with the quark-parton model. (FR)

4651 EXPERIMENTAL RESEARCH OF NEUTRAL CURRENTS IN NEUTRINO INTERACTIONS. Lutz-Burban, A. M. (Ecole Normale Superieure, Orsay, France). pp 281-304 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

These last years, several experiments tried to observe some neutrino interactions for which neutral current contributions are necessary. This research, which interest was brought into fashion by recent renormalizable theories of weak interactions which require the existence of neutral current, is reviewed. (FR)

4652 HIGHER ORDER CALCULATIONS IN GAUGE THEORIES. Lautrup, B. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). pp 345-377 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The results of various one-loop calculations made in the framework of unified gauge theories for weak and electromagnetic interactions are discussed. Most emphasis is given to the purely leptonic aspects and the discussion is limited to calculations for which the finite part has been evaluated: the anomalous magnetic moment of the leptons, the static electromagnetic properties of the intermediate vector boson, elastic neutrino-electron scattering and corrections to the muon decay rate. (FR)

4653 ASYMMETRY PARAMETERS IN WEAK RADIATIVE Σ AND Λ DECAYS. Reid, J. H. (Univ. of Calgary, Alberta); Trofimenkoff, N. N. Lett. Nuovo Cim.; 9: No. 11, 421-425(16 Mar 1974).

It is shown that the contributions of the πN intermediate state and the octet baryon pole terms to weak radiative decay amplitudes leads to nonzero values for the asymmetry parameter α. In particular, the calculated value $\alpha = -0.28$ for the decay $\Sigma^+ \to p\gamma$ has the same sign and order of magnitude as the experimental result of Gershwin. (LBS)

4654 THE HELICITY AMPLITUDE APPROACH TO LOW ENERGY THEOREMS. Dombey, N. (University of Sussex, School of Mathematical and Physical Sciences, Brighton BN19QH, Sussex, England); McKenzie, N.C. Ann. Phys. (N.Y.) 78: No. 2, 535-552 (June 1973).

It is shown that "low energy theorems" for charged vector and axial vector currents have a natural derivation in terms of helicity amplitudes. This is done by reconsidering the kinematic constraints as a function of the virtual photon mass, λ. The crucial point is that in general a certain limit of the longitudinal amplitudes is required as an input to the theorem. Two new $\nu\pi$ sum rules are also obtained. (auth)

4655 GENERALIZED FIXED-MASS SUM RULES. Dicus, D.A. (University of Rochester, Rochester, New York 14627); Palmer, D.R. Ann. Phys. (N.Y.) 79: No. 1, 68-98 (July 1973).

Light-cone commutation relations have been shown to be the natural commutators to use to derive fixed mass (fixed spacelike q^2) sum rules for the structure functions which describe lepton hadron scattering. In this paper we review, in detail, the structure of the light-cone commutators and the methods used to derive sum rules. We then derive new sum rules by using two generalizations of the previous method; (1) we use the light-cone commutator of moments of currents by considering derivatives of the Fourier transform of the current and (2) we expand the integrals in a power series in q^2 before fixing q^2. The new sum rules involve derivatives of the structure functions with respect to q^2 and/or ν. Except for one short separate calculation we consider only conserved vector currents. For the most part we do not sum over the nucleon spin nor restrict ourselves to the forward direction. Our emphasis is on the type of information contained in the different techniques of derivation and we particularly emphasize which sum rules can be derived from the least model dependent commutator. (auth)

4656 MORE RADIATIVE CORRECTIONS FOR β-DECAY. Bace, M. (Max-Planck-Inst. for Physics and Astrophysics, Munich). Nucl. Phys.; B71: No. 2, 292-300(1974).

A calculation is performed of a hitherto ignored "radiative" correction to neutron β-decay. Conventional electromagnetism does not allow $\eta \to 3\pi$ decay; the mechanism responsible for this decay will lead to a correction to β-decay not taken into account by the standard $O(\alpha/\pi)$ correction of one-photon exchange. While an order of magnitude estimate indicates this correction could in principle compete with the one-photon-exchange correction, explicit calculation puts it at three orders of magnitude down. Thus the agreement between the Cabibbo $\cos\theta$ and the $\sin\theta$ obtained from $\Delta S = 1$ decays remains unspoilt. (auth)

4657 ANALYTICITY OF THE K_{l3} DECAY FORM FACTOR IN THE CHIRAL SYMMETRY BREAKING PARAMETERS. Wada, S. (Tokyo Univ.). Phys. Lett.; 49B: No. 2, 175-177(1 Apr 1974).

Langacker and Pagels have shown that the K_{l3} decay form factor is renormalized by the term $\sim \epsilon_\delta^2/\epsilon_0$. This expression has a pole at $\epsilon_0 = 0$. It is recalculated by considering the phase transition and it is found that this form factor can be continued to the whole ϵ_0-ϵ_δ plane not analytically but continuously and is finite everywhere. (auth)

4658 DETERMINING THE $K_S \to 3\pi$ AMPLITUDE IN $\bar{p}p$ (OR e^+e^-) $\to K^0\bar{K}^0$. Dass, G. V. (DESY, Hamburg). Phys. Lett.; 49B: No. 2, 181-184(1 Apr 1974).

The amplitude ratio $\langle 3\pi|T|K_S\rangle/\langle 3\pi|T|K_L\rangle$ can be well determined in e^+e^- (or low energy $\bar{p}p$) $\to K^0\bar{K}^0$ from the decay time-distribution when each produced kaon $\to 3\pi$, other unknown parameters of the distribution being obtainable from corresponding observations involving known channels like $\pi\pi$. (auth)

4659 EXPERIMENTAL IMPLICATIONS OF WEINBERG'S MODEL WITH HAN-NAMBU QUARKS. Achiman, Y.; Gromes, D.; Rothe, H. J.; Bender, I. (Univ., Heidelberg). Nuovo Cim., 21A: No. 1, 45-63(1 May 1974).

The consequences of the existence of heavy neutrinos, neutral currents and charmed particles are discussed in a previously proposed gauge model with HN quarks. It is found that the lower bounds on neutral-current neutrino production are suppressed as compared to Weinberg's model. On the other hand the coupling of electrons and muons to neutral currents is enhanced. As a consequence $\sigma_{weak}(e^+e^- \to \mu^+\mu^-) = 81\sigma_{weak}^{Weinberg}(e^+e^- \to \mu^+\mu^-)$ and a considerable specific violation of scaling in μp scattering at NAL energies is predicted. The sum rules for the structure functions in deep inelastic scattering above the threshold for charmed-particle production are given. (auth)

4660 BOUNDS OF WEAK INTERACTION AMPLITUDES. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 9: No. 15, 612-614(13 Apr 1974).

It is pointed out that the usual proof of the Froissart bound does not apply for weak processes. It is shown that a bound may be obtained on weak amplitudes by making an assumption concerning the functional form of the amplitudes in the asymptotic energy region and by making use of a unitarity relation for elastic weak processes. (LBS)

4661 RELATIONSHIP BETWEEN $f_+(0)$ AND S, D AMPLITUDES IN 1^+ MESON DECAYS. Goni, M. A. (Univ., Saragosse, Spain). An. Fis.; 68: No. 10-12, 287-290(1972).

Using the method of Fubini and Furlan, the relation between the value at $t = 0$ of the form factor and the decay amplitudes S and D are discussed for semileptonic kaon decay. (JFP)

4662 COMPARISON OF THE MUON AND NEUTRON LIFETIMES IN A GAUGE FIELD MODEL. Angerson, W. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys.; B69: No. 3, 493-501(1974).

The corrections to the lifetimes of the muon and neutron are compared in Weinberg's model of leptons, extended to include the weak and electromagnetic interactions of the nucleons. (auth)

Strong (General)

Refer also to abstracts 4739, 5191, and 5272.

4663 (NP-19996) STUDY OF DUAL MODELS IN THE THEORY OF STRONG INTERACTIONS. Brink, L. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden)). 1973. 103p. Dep. NTIS (US Sales Only) $8.25.

Thesis.

The basic features of the strong interaction in the fields of nuclear and elementary particle reactions are discussed. The field-theoretic and S-matrix approaches to the construction of a theory for the strong interaction are reviewed. Some simple phenomenological tests of the theory of strong interaction are discussed. Dual resonance models are discussed in terms of: four-particle amplitudes; N-particle amplitudes; the operator formalism of the Veneziano model; the algebraic properties of the Veneziano model with unit intercept; unitarity corrections; the Neveu-Schwarz model; fermions in dual models; and the string interpretation of dual models. Attempts to construct new models are discussed. (BRH)

4664 (RHEL-72-1(Vol. 1), pp 415-447) TWO-BODY HADRON-HADRON INTERACTIONS. Michael, C. (CERN, Geneva). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The discussion of two-body hadron-hadron interactions covers the basic empirical ingredients needed in a description of two-body scattering, the phenomenological tool of amplitude analysis and applications and techniques for the investigation of pseudoscalar meson-baryon scattering, a survey of models, unnatural parity exchange, vector meson production, and vacuum quantum number exchange. (JFP)

4665 ANALYTICAL S-MATRIX PROGRAM AND ADAPTIVE INTERPRETATION OF THE THEORY OF HADRON PROCESSES. Potupa, A. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 116-118(1974). (In Russian).

The possibility of the statistical closure of the S-matrix approach with consideration of the incompleteness of the experimental data in the area of large final multiplicity was examined for the case where sufficiently complete fitting was done for medium values, exclusive cross sections, one-particle spectra, and two-particle correlation. The quadratic amplitude modulus plays the role of microcanonical probability distribution with adaptive construction algorithm. (tr-auth)

4666 THE RENORMALIZED σ MODEL. Kim, K.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 79: No. 2, 287-337 (Aug 1973).

A renormalization procedure of the boson σ model based on the finite field equations of Brandt-Wilson is given. We first show that the current operators appearing in the field equations, which are finite local limit of sums of nonlocal field products and suitable subtraction terms, can be chosen to be the same form as the one given for the symmetric limit except for the symmetry breaking constant source term itself. The set of integral equations derived from the field equations is shown to be equivalent to the usual Bogoliubov-Parasiuk-Hepp renormalization theory, and gives us immediately all the renormalized Green's functions in each order of perturbation theory in clear and straightforward fashion. We then analyze the structures of the model in detail. In particular, Ward identities are shown to be satisfied to all orders of perturbation theory. The Goldstone theorem is a particular consequence of these identities. (auth)

4667 THEORY OF HADRON REACTIONS AT VERY HIGH ENERGIES. Potupa, A. S. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR; 18: No. 1, 21-24(Jan 1974). (In Russian).

With increasing energy of colliding hadrons, multiple production becomes the dominant type of process in strong interactions. The average multiplicity of secondary particles $\bar{n}$ (s) increases with energy significantly more slowly than the maximum allowable ($n_{max}(s) \sim \sqrt{s}$), and all distributions in n (topological spectra and cross sections) have maxima at n close to $\bar{n}$. The asymptotic growth of the average particle multiplicity $\bar{n}$ with energy $\sqrt{s}$ assures the existence of a region of very high energies, where all the real channels of multiple production (with n close to $\bar{n}$) enter an asymptotic regime ($n_{max} \gg n$, where $n_{max}(s)$ is the maximum allowable number of generated particles). In the limit $n \to \infty$ the theory of hadron reactions is associated with processes of very great particle multiplicity, and should be simplified by using a statistical approach to describing the spectra. The tail of the distribution in n ($\bar{n} \ll n < n_{max}$) can be described on the basis of a model of threshold production (hypothesis of homogeneous distribution in momentum space). Estimates of spectra in both regions are presented. (SJR)

4668 NONSCALING BEHAVIOR IN PARTON MODELS FOR LARGE TRANSVERSE MOMENTA. Ellis, S. D. (CERN, Geneva). Phys. Lett.; 49B: No. 2, 189-193(1 Apr 1974).

The possibility of non-scaling contributions to large transverse momentum processes is discussed within the context of simple parton-parton scattering models. The models are extended slightly to include the "quasi-exclusive" production of π's as a threshold effect in the function G(y) which describes the evolution of partons into hadrons. The resulting non-scaling $P_\perp^{-6}$ contribution is particularly enhanced in large $P_\perp$ processes, compared to the usual $P_\perp^{-4}$ term, and the dominance of this term in the present data can be explained if the scale which now appears has a value $M_0 \geq 4$ GeV or if naive Bloom-Gilman duality, as applied here, is broken. (auth)

4669 BOUND STATES IN THE COLORED-QUARK MODEL. Capps, R. H. (Purdue Univ., West Lafayette, IN). Phys. Lett.; 49B: No. 2, 178-180(1 Apr 1974).

The saturation problem in the three-triplet quark model, discussed previously by Nambu and by Lipkin, is investigated. It is proved that in a simple version of the model, the only bound states of any color representation and any numbers of quarks and antiquarks are the $q\bar{q}$ (meson), qqq (baryon), and a heavier diquark state. (auth)

4670 SEMIINCLUSIVE TWO-PARTICLE CORRELATIONS AND INDEPENDENT CLUSTER EMISSION AT ISR ENERGIES. Ranft, J.; Ranft, G. (Karl-Marx-Univ., Leipzig). Phys. Lett.; 49B: No. 3, 286-290(15 Apr 1974).

Semi-inclusive two-particle correlations are calculated in the independent cluster emission model. The resulting semi-inclusive

correlation functions ρ_2^0 ($\gamma_1 = \gamma_2 = 0$) agree rather well with experimental data, esp. with respect to the multiplicity dependence. The average number of charged particles per cluster found from comparison with semiinclusive data is 2.5 charged particles per cluster, a value found earlier also from analysis of inclusive correlations. (auth)

4671 QUARK–QUARK INTERACTIONS AND HIGH ENERGY PROCESSES. Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Lett.; 49B: No. 3, 277-279(15 Apr 1974).

The speculation that quark–quark amplitudes are only scale free at high energy and fixed angle if the virtual quark masses are also large, is shown to have some interesting consequences for e^+e^- annihilation and for hadronic processes at large transverse momentum. (auth)

4672 ARE THERE REASONS TO DOUBT THE OPTICAL THEOREM. Hoehler, G.; Kroll, P. (Univ., Karlsruhe, Ger.). Phys. Lett.; 49B: No. 3, 280-282(15 Apr 1974).

In a recent paper Kupczynski discussed the "serious and urgent" problem that certain hadron–hadron forward cross sections seem to violate strongly the optical theorem. It is the purpose of this note to point out that there are no indications for a violation, if the data are analysed as careful as it is necessary. In particular one should notice that details of the shape of the diffraction peak have to be determined from experiments. There exists no theoretical argument in favour of an exact exponential t-dependence. (auth)

4673 INTERACTING STRING AND DUAL-RESONANCE MODEL. Ademollo, M. (Univ., Florence); D'Adda, A.; D'Auria, R.; Napolitano, E.; Sciuto, S.; Di Vecchia, P.; Gliozzi, F.; Musto, R.; Nicodemi, F. Nuovo Cim.; 21A: No. 1, 77-145(1 May 1974).

The problem of an interacting string is studied. In the case of an open string the interaction is introduced by adding in the Lagrangian an additional term which describes the interaction of the string with an external "photonlike" field. The interaction is acting only at the ends of the string to keep the invariance of the Lagrangian under reparametrization. The equation of motion of the string is exactly solved in the case of a monochromatic external field. All the spectrum properties already known in the case of a free string are left unchanged by the interaction. In addition it is shown that the probability of emission of n "photons" off the string reproduces the dual amplitude of the conventional model with "photons" as external particles. In the case of a closed string the interaction is obtained by introducing in the free Lagrangian a four-dimensional metric tensor $g_{\mu\nu}(x)$ associated with a curved space as in the theory of general relativity. Also in this case the equation of motion of the string in an external "gravitational" field is exactly solved for a monochromatic "graviton" field. All the main features of the Shapiro–Virasoro model are then reproduced starting from this description of a closed string. (auth)

4674 MULTIPERIPHERAL INCLUSIVE EQUATIONS, CLUSTERS, AND SCALING. Dremin, I. M.; Dunaevskii, A. M. (Lebedev Inst. of Physics, Moscow). Lett. Nuovo Cim.; 9: No. 15, 627-632(13 Apr 1974).

Multiperipheral equations for inclusive spectra are derived from the exact field-theory Bethe–Salpeter equation, the solution of which requires the production of heavy clusters in the multiperipheral chain. It is shown that their solutions can be split into the nonperipheral, fragmentation and pionization parts and can be considered as a generalization of the Mueller approach. The shapes of produced clusters are considered for the scaling problem. (LBS)

4675 POSSIBLE INTERPRETATION OF SOLAR NEUTRINO AND MONT BLANC MUON EXPERIMENTS IN TERMS OF NEUTRINO–BOSON COLLISIONS. Moles, M.; Vigier, J. P. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 9: No. 16, 673-676 (20 Apr 1974).

The low counting rate of neutrinos observed in the Brookhaven neutrino solar experiment is explained by introducing a new strong interaction between neutrinos, bosons, and photons. The solar ν_e's are assumed to interact with the ϕ bath (ϕ is some unknown neutral (pseudo)-scalar boson) surrounding the Sun and produce ν_μ's through the reaction $\nu_e + \phi \rightarrow \nu_\mu + \phi$. It is also shown that the excess ν_μ's thus produced can account for the excess muons observed in the Mont Blanc experiments. (LBS)

4676 MODELS OF FLAT REGGE TRAJECTORIES. Fleming, H.; de Haro, R. Jr. (Univ., Sao Paulo, Brazil). Rev. Brasil. Fis.; 3: No. 2, 317-325(Oct 1973).

Dispersion relations are exploited to obtain models of Regge trajectories. For trajectories that tend to a constant, at large s, a systematic procedure is developed and several examples are presented. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 4725, 4736, 5252, and 5286.

4677 (BNL-18687) REVIEW OF MESON SPECTROSCOPY. Eisner, R. L. (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1974. 84p. (CONF-740122-1). Dep. NTIS $7.25.

From second international winter meeting on fundamental physics; Formigal, Spain (28 Jan 1974).

A general review is presented for meson spectroscopy, and some of the problems are pointed out. Low mass enhancements–Q, A_1, etc., the 1.0-GeV region of nonstrange bosons, $\bar{p}p$ cousins: D, E, F_1, and high mass K**'s are discussed. (JFP)

4678 EARLY SCALING AND THE ALGEBRA OF VERTEX STRENGTHS. Koca, M.; Oenenguet, G. (Middle East Technical Univ., Ankara). Lett. Nuovo Cim.; 9: No. 11, 435-440(16 Mar 1974).

It is shown that the present one-particle inclusive data are compatible with the parametrization in the CHN algebra of vertex strengths. It is also shown that early scaling is consistent with this parametrization. By making use of this data, predictions are made for the cross sections of the two particle inclusive reactions in the fragmentation region. (LBS)

4679 PHENOMENOLOGY OF LOW-ENERGY $\pi\pi$ SCATTERING. Johnson, R.C. (Mathematics Department, Durham University, England). Ann. Phys. (N.Y.) 78: No. 2, 352-375 (June 1973).

Exact representations of the low-energy $\pi\pi$ amplitudes by (for the S-waves) generalized effective range formulas and by (for the P-wave) a resonance plus background expression are derived from inverse-amplitude partial-wave dispersion relations, and applied to the phenomenological analysis of a typical set of phase shifts deduced from peripheral pion production. With the aid of rigorous crossing conditions it is found that the simplest satisfactory account of the S-waves is provided by a current algebra type solution with (Adler) zeros and small scattering lengths. Solutions without zeros (S-wave dominant) are completely ruled out. Inelasticity is important in describing the rise of the isoscalar phase shift above the δ resonance, but can be neglected below 1 GeV in other channels. The P-wave is ρ-dominated, but its width is sensitive to background terms. The phenomenological importance of rigorous results is stressed. (auth)

4680 SIMPLE LOWER BOUND FOR THE $\pi^0\pi^0$ TOTAL CROSS SECTION. Palou, F. P. (Rutherford Lab., Chilton, Eng.). Lett. Nuovo Cim.; 9: No. 15, 615-618(13 Apr 1974).

It is shown that a lower bound for the s-wave contribution to the $\pi^0\pi^0$ cross section can be obtained by using only the value of certain low-energy physical parameters. (LBS)

4681 SOLUBLE REALISTIC MODEL FOR LOW ENERGY $\pi\pi$ SCATTERING. Johannesson, N. (CERN, Geneva). Nucl. Phys.; B69: No. 3, 557-561(1974).

Using analyticity, crossing and unitarity and making a few approximations, the $\pi\pi$ scattering amplitudes are predicted in terms of the S-wave scattering lengths from threshold up to 800 MeV. (auth)

4682 GENERALIZED CRICHTON-LIKE AMBIGUITIES. Atkinson, D. (State Univ., Groningen, Netherlands). Z. Phys.; 266: No. 5, 373-376(Feb 1974).

The treatment of two-fold ambiguities in elastic scattering is extended by considering only even or only odd waves, and by allowing nonzero inelasticities. Physical applications of these results to $\pi\pi$ and to $\alpha\alpha$ scattering are considered. (GE)

4683 CONSTRAINTS ON THE LOW-ENERGY $\pi\pi$ ISOSPIN 0 S-WAVE FROM ELASTIC πN SCATTERING. Nielsen, H.; Oades, G. C. (Univ., Aarhus, Denmark). Nucl. Phys.; B72: No. 2, 321-328(1974).

It is shown that the behaviour of the reduced πN d-waves close to the physical threshold is very sensitive to the value of the low-energy isospin 0 s-wave $\pi\pi$ phase. The slopes of the d-waves at threshold favour a $\pi\pi$ scattering length $a_0^0 \sim 0.10$, the errors being small enough to rule out a scattering length as large as 0.60. Similar conclusions are reached by considering a fixed ν dispersion relation at $\nu = 0$ for the amplitude $C^{(+)}$. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 4568, 4935, and 5162.

4684 (CRN/HE-73-15) NOTE ON THE MASSES OF LEPTONS AND BARYONS. Becker, F. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de

Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1973. 6p. Dep. NTIS (US Sales Only) $4.00.

Heuristic arguments are used to express the masses of stable baryons, two charged leptons, and neutrinos in terms of a universal mass of 70 MeV, and the well known coupling constants for strong, electromagnetic, and weak interactions, all the masses being expressed by integer or half integer numbers. An accuracy of better than 1% is achieved, and the results are consistent with SU(3) symmetry. Five mass formulas are given. (auth)

4685 EFFECTIVE ANGULAR-MOMENTUM BARRIER IN THE SU(3) TEST OF REACTIONS INVOLVING PSEUDOSCALAR MESONS. Takasugi, E.; Oneda, S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 31: No. 20, 1274-1278 (12 Nov 1973).

SU(3) in particle reactions involving pseudoscalar mesons is discussed in the framework of chiral SU(3) ⊗SU(3) charge algebra, partial conservation of axial-vector current, and asymptotic SU(3). (auth)

4686 $\eta N \to \eta N$, $\eta N \to \pi N$ TOTAL CROSS SECTIONS IN THE $S_{11}(1535)$-RESONANCE REGION. Dudkin, G. N.; Eponeshnikov, V. N.; Krechetov, U. F.; Tryasuchev, V. A. (Inst. for Nuclear Physics, Tomsk, USSR). Lett. Nuovo Cim.; 9: No. 11, 452-455 (16 Mar 1974).

The cross sections of the processes $\eta N \to \eta N$ and $\eta N \to \pi N$ are calculated in the energy region of the η-meson from 1 to 300 MeV. The amplitudes of these processes are written in the pole approximation by taking into account the nucleon and the $S_{11}(1535)$ resonant state. The calculated value for the total cross section $\sigma(\eta N)$ is found not to contradict the experimental data. The value of the coupling constant $g_{\eta NN}$ is found in reasonable agreement with the value predicted by SU(3) symmetry. The width Γ of the $S_{11}(1535)$ resonant state is found to contradict the experimental data. (LBS)

4687 K-MATRIX ABSORPTION MODEL FOR THE PION NUCLEON SYSTEM. Drechsler, W. (Max-Planck-Institut für Physik und Astrophysik, Munich, Germany). Ann. Phys. (N.Y.) 80: No. 1, 157-188 (Sept 1973).

A model based on a multichannel K-matrix formalism is used to analyze pion-nucleon scattering data. The Pomeranchuk term has in this description both a helicity nonflip and a helicity flip component, each one being capable of showing besides the dominant imaginary part a small real contribution. This more complicated nature of the vacuum terms implies a more involved absorptive correction for the Reggeized input Born terms being now different for helicity nonflip and helicity flip transitions. It is shown that such a model which builds up, via unitarity, the Pomeranchuk contribution from multiple exchanges of lower lying trajectories, generating at the same time a definite absorption mechanism in two-body scattering processes, describes well elastic $\pi^{\pm}p$ scattering and accounts for details of the $\pi^{-}p$ charge exchange reactions such as the dip structure of the differential cross section and the polarization. (auth)

4688 REGGE RESIDUES FOR πN CHARGE EXCHANGE AMPLITUDES. Braathen, H. J. Ark. Fys. Seminar Trondheim; No. 1, 1-33(1974).

New p,p′ Regge residues for πN charge exchange amplitudes are calculated, using E. Pietarinen's amplitude analysis as input in dispersion relations. Sum rules out to lab. momentum 9.5 GeV/c are used. The results in the asymptotic region, for $0 < -t < .55(\text{GeV})^2$ are in good agreement with the input and with new experiments. (auth)

4689 PHENOMENOLOGICAL STUDY OF THE DIFFERENTIAL CROSS SECTION OF πp AND Kp ELASTIC SCATTERING AT 5 AND 10 GeV AT ALL ANGLES. Savoy-Navarro, A. (CERN, Geneva). Lett. Nuovo Cim.; 9: No. 15, 609-626(13 Apr 1974).

A phenomenological study is made of Kp and πp elastic scattering in the small-, intermediate-, and large-angle regions on the basis of two complementary mechanisms: the dual absorptive model and a parton model. The data in the intermediate angle region are then examined in terms of the interference of both mechanisms. (LBS)

4690 RADIATIVE PION-PROTON SCATTERING IN THE REGION OF THE $\Delta(1236)$ RESONANCE. Musakhanov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 630-639(Mar 1974). (In Russian).

A model is proposed to enable one to separate the contribution from the isobar magnetic moment to the cross section of radiative $\pi^{+}p$-scattering process. Analysis of the soft-pion limit makes it possible to relate a number of parameters in the radiative $\pi^{+}p$-scattering amplitude to parameters in the pion neutrino-production amplitude. Treating the data of a recent experiment one gets for the isobar magnetic moment the value of $\mu_{\Delta^{++}} = 3.6 \pm 2.0$. (JINR)

4691 ρN-INTERACTION ON BASIS OF THE DATA ON INCOHERENT ρ-MESON PRODUCTION ON CARBON NUCLEI BY 3.72 GeV/c π^{-}-MESONS. Aref'ev, A. V.; Bayukov, Yu. D.; Efremenko, V. I.; Zaitsev, Yu. M.; Kozodaev, M. S.; Korotkikh, V. L.; Kuleshova, L. N.; Leksin, G. A.; Suchkov, D. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 3, 600-607(Mar 1974). (In Russian).

Results are presented on a study of the $\pi^{-}A \to \rho^{0}A'$ reaction on the ^{12}C nucleus at $p_{\pi} = 3.72$ GeV/c. Using the value of N_{eff}, obtained in framework of the Glauber-Margolis model, the total ρ-meson-nucleon cross section is determined, $\sigma_{\rho N} = (24 \pm 4)$ mbarn (the systematic error is ~40%) at $p_{\rho} \approx 3.6$ GeV/c. The obtained quantity is in agreement, up to the errors, with the cross section determined by other, different in principle, methods. (auth)

4692 DIFFERENTIAL CROSS SECTION AND N* SPIN DENSITY MATRIX OF $\pi N \to \pi N^{*}$ AND SU(6) × O(3) STRUCTURE. Hirano, M. (Hokkaido Univ. of Education, Sapporo); Iwata, K.; Matsuda, Y.; Miyakoshi, T.; Murota, T. Progr. Theor. Phys. (Kyoto); 50: No. 4, 1347-1356(Oct 1973).

On the basis of the symmetric quark model, $d\sigma/dt(\pi N \to \pi N^{*})$ and its N* spin density matrix for N* which lies on N_{α} and N_{γ} trajectories are calculated by using the Barger-Phillips $\pi N \to \pi N$ amplitude as input. Agreement with experiment is satisfactory. It is predicted that the polarization distribution of the decay product N of N* is determined mostly by the SU(6) structure of N* and behaves quite differently depending on different SU(6) structures. (auth)

4693 DEGENERACY OF THE BARYON SPECTRUM IN THE HARMONIC SYMMETRIC QUARK MODEL. Alcaras, J. A. C.; Ferreira, P. L. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Rev. Brasil. Fis.; 3: No. 2, 327-336(Oct 1973).

The counting problem for the number of linearly independent homogeneous polynomials in six variables with definite permutational symmetry under S_3 is solved. The solution of the analogous problem for homogeneous and harmonic polynomials is also given. The results are applied to the calculation of the degeneracies of the the baryonic levels in quark models, specially in the harmonic symmetric quark model. (auth)

4694 LOW ENERGY πN PARTIAL WAVES, EXPANSIONS OF THE πN INVARIANT AMPLITUDES ABOUT $\nu = 0$, $t = 0$ AND THE VALUE OF THE CURRENT ALGEBRA SIGMA TERM. Nielsen, H.; Oades, G. C. (Univ., Aarhus, Denmark). Nucl. Phys.; B72: No. 2, 310-320(1974).

Using new experimental information on low-energy πN elastic scattering both the low-energy partial waves and the expansion coefficients of $\bar{C}^{(s)}$ and $\bar{B}^{(s)}$ about the point $\nu = 0$, $t = 0$ are recalculated. These values are used to recalculate the πN σ term obtaining 66 ± 9 MeV. Comments are made on some other recent determinations of this quantity. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 4845, 4846, and 4872.

4695 EXPLANATION OF RISING MULTIPLICITY WITH INCREASING PERPENDICULAR MOMENTUM TRANSFERRED TO THE LEADING PROTON, USING THE QUARK MULTIPLE-SCATTERING MODEL. Kanofsky, A.S. (Department of Physics, Lehigh University, Bethlehem, Pennsylvania 18015); Klenk, K.F. Phys. Rev. Lett. 31: No. 21, 1323-1325 (19 Nov 1973).

It is shown that the rise in multiplicity with increasing perpendicular momentum transferred to the leading proton seen in recent experiments can be simply explained as due to double quark-quark scattering in the Glauber quark multiple-scattering model. The quark-quark inelastic-scattering amplitude is entirely consistent with the quark-quark elastic amplitudes obtained previously for elastic proton-proton scattering. (auth)

4696 THEORETICAL PHASE SHIFT ANALYSIS IN THE (n,d) ELASTIC SCATTERING. Lamot, G. H.; Fayard, C.; Elbaz, E. (Univ., Lyon). Lett. Nuovo Cim.; 9: No. 16, 653-658(20 Apr 1974).

Phase shifts and mixing parameters for n-d elastic scattering are evaluated for different types of nonlocal interactions, with and without P waves. Vector polarizations are obtained in good agreement with experiment. The defects of the parametrizations used are emphasized and the disagreement between experimental and theoretical observables is explained. (LBS)

4697 CALCULATION OF THE DISTRIBUTION OF PROTONS FROM THE REACTION n + d → n + n + p FOR 14-MeV NEUTRONS. Muscalu, S. C. (Bucharest Univ.). An. Univ. Bucuresti, Fiz.; 21: 5-7(1972).

By using the summation method of the nonrelativistic diagrams corresponding to the inelastic scattering of nucleons on deuterium,

the energy spectrum of protons from the reaction n + d → 2n + p is calculated. Differential cross sections are found. (JFP)

4698 MULTIPLICITY MOMENTS OF THE CHARGED PARTICLES FROM A SIMPLE GEOMETRICAL PICTURE AT HIGH ENERGIES. Nakamura, H. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 9: No. 11, 426-431(16 Mar 1974).

It is shown that the universal distribution for the charge multiplicity for pp interactions can be derived from a simple geometrical model and gives multiplicity moments which are in good agreement with experimental data. (LBS)

4699 PHOTON EMISSION AND OTHER PARTICLE PRODUCTION AS ORIGIN OF RISING TOTAL CROSS SECTIONS IN HIGH ENERGY PROTON-PROTON COLLISION. Suzuki, M. (Univ. of California, Berkeley). Lett. Nuovo Cim.; 9: No. 11, 441-446 (16 Mar 1974).

Real-photon emission is discussed in the model of the vector-meson dominance for the photon. It is found that the rise in total cross sections in high-energy pp interactions cannot be explained by the real-photon emission. A speculation is made on other possible origins of the increasing total cross section. (LBS)

4700 A DENSITY EXPANSION OF THE PION-NUCLEUS OPTICAL POTENTIAL. II. SECOND ORDER TERMS. Dover, C.B. (Brookhaven National Laboratory, Upton, New York 11973). Ann. Phys. (N.Y.) 79: No. 2, 441-479 (Aug 1973).

The second order terms in a density expansion of the pion optical potential V_{opt} are evaluated quantitatively. The coefficients of these terms are proportional to various combinations of on- and off-shell nucleon-nucleon T-matrices, averaged over the distribution of two nucleon relative momenta in the Fermi sea. The on-shell contributions can be obtained directly from experimental phase shifts, but the calculation of the off-shell-parts requires a model for the nucleon-nucleon potential. We consider a number of realistic local and nonlocal, separable potentials which fit nucleon-nucleon phase shifts, in order to study the variations in V_{opt} which arise from differences in the off-shell behavior of T. We find absorptive (imaginary) and dispersive (real) contributions to V_{opt} which are of comparable magnitude. The dispersive part, which leads to a real energy shift associated with the two nucleon absorptive process, has not been previously estimated quantitatively. We compare our results to empirical potentials obtained by fitting energy level shifts and widths in pi-mesic atoms, as well as theoretical estimates based on threshold cross sections for the processes $\pi + N + N = N + N$. (auth)

4701 A POTENTIAL MODEL FOR HYPERON-NUCLEON SCATTERING. Nagels, M.M.; Rijken, T.A.; De Swart, J.J. (Institute for Theoretical Physics, University of Nijmegen, Nijmegen, The Netherlands). Ann. Phys. (N.Y.) 79: No. 2, 338-385 (Aug 1973).

Low energy ΛN- and ΣN-scattering has been calculated in a potential model by solving the multichannel Schrödinger equation. Meson theoretic potentials are used which describe the exchange of nonets of pseudoscalar and vector mesons and uncorrelated two pion exchange. At short distances hard cores are employed. Coupling constants are taken from SU(3), SU(6), and the conserved current theory for vector mesons. Coulomb effects are included and different baryon masses within isomultiplets are considered. Charge symmetry breaking between the Λp- and Λn-channel due to one pion and one rho exchange has been taken into account. The model is checked in nucleon-nucleon scattering where it gives a good qualitative description of the NN-phaseshifts below the pion production threshold. A least-squares fit to the low energy Λp, Σ^+p, and Σp data yields a very satisfactory result. The model leads then to the low energy parameters of Σ^+p: $a^e_s = -2.42 \pm 0.30$ fm, $r^e_s = 3.41 \pm 0.30$ fm, $a^e_t = +0.71$ fm, $r^e_t = -0.78$ fm. The scattering lengths a and effective ranges r for Λp are $a^p_s = -2.16 \pm 0.26$ fm, $r^p_s = 2.03 \pm 0.10$ fm, $a^p_t = -1.32 \pm 0.07$ fm, $r^p_t = 2.31 \pm 0.08$ fm, and for Λn $a^n_s = -2.67 \pm 0.35$ fm, $r^n_s = 2.04 \pm 0.10$ fm, $a^n_t = -1.02 \pm 0.05$ fm, $r^n_t = 2.55 \pm 0.10$ fm. The possible existence of $^3S_1$ resonances in the neighborhood of the ΣN thresholds is discussed. Coupled channel effective range expansions are given around the ΣN-thresholds. (auth)

4702 ISR DATA ON PP ELASTIC SCATTERING AND MULTIPLE SCATTERING IN THE COMPOSITE MODEL. Wakaizumi, S. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 5, 1760-1762(Nov 1973).

The dip-bump structure of the differential cross section of pp elastic scattering at ISR energy $E_{cm} = 53$ GeV is analyzed on the basis of a multiple scattering model based on the composite model for hadrons. It is examined whether the forward and large angle scattering behavior of the pp elastic process are explained systematically by the same mechanism based on the composite model from low and intermediate energy to extremely high energy in the ISR region. (LBS)

4703 CALCULATIONS OF THE π-DEUTERON SCATTERING LENGTH. Bendix, P.; Beder, D. (Univ. of British Columbia, Vancouver). Phys. Lett.; 49B: No. 2, 140-142(1 Apr 1974).

Multiple scattering calculations of the π-d scattering length are presented which include higher order scattering with as much care as appears feasible to us. (auth)

4704 TREIMAN-YANG TEST FOR d + d → d + p + n. Ijpenberg, A. D.; van Dantzig, R.; Wielinga, B. J.; Slaus, I. pp 651-654 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug (1972).

The d + d → d + p + n reaction is known to be dominated by QFS behavior and disturbing strong final-state interactions are absent. It is therefore suited for a Treiman-Yang test. A study on deuteron induced deuteron break-up at 26.5 MeV is reported. It is concluded that the Treiman-Yang test on the data shows not even a marginal deviation from consistency with the single-pole approximation (for $q < 0.2$ fm^{-1}), whereas the quasi-elastic angular dependence deviates from the elastic angular distribution and thus provides a sensitive measure for either a contribution of other processes or off-shell scattering effects. (auth)

4705 POMERANCHUK'S TRAJECTORY AND DEUTERON FORM FACTOR. Il'in, V. V.; Tutik, R. S. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 147-150 (Jan 1974). (In Russian).

The results of experiments on the measurement of the differential cross section of elastic pp scattering carried out at energies s 3000 $(GeV)^2$ serve as a basis for the introduction of nonlinear Pomeranchuk trajectories. The values of the deuteron form factor obtained by use of the linear and nonlinear parametrization of the Pomeranchuk trajectory, according to data on the elastic pd scattering at 10 to 70 GeV, were compared with the experiment data on ed scattering. The necessity of considering the curvilinear Pomeranchuk trajectory at energies above 10 GeV was shown. (tr-auth)

4706 MULTIPERIPHERAL TWO-COMPONENT MODEL. Squires, E. J.; Webber, D. M. (Univ. of Durham, Eng.). Nuovo Cim.; 21A: No. 1, 64-76(1 May 1974).

A fit is made to fit the multiplicity distribution for negative particles produced in pp collisions at high energy. The model contains a multiperipheral component together with a pomeron exchange component, which is calculated with the assumption that the multiplicity distribution in pomeron-proton collisions is the same as that in proton-proton collisions. In order to obtain the required low multiplicity for the pomeron component it is necessary to assume that the pomeron-proton cross-section falls off very rapidly with energy. (auth)

4707 REGGE POLE FIT TO THE DECK-PEAK IN THE REACTION pp → $\Delta^{++}p\pi^-$ AT 19 GeV/c INCIDENT MOMENTUM. Brink, L. (CERN, Geneva); Holmgren, S. O. Phys. Scr.; 8: No. 6, 231-235(Dec 1973).

The process pp → $\Delta^{++}p\pi^-$ at 19 GeV/c incident momentum is investigated using a doubly reggeized model. Interest is concentrated on the effect of reggeization. The model is found to describe the data rather well but it is still clear that the model is too simple to describe all details at this energy. Attempts to get a realistic Toller angle dependence do not alter this conclusion. (auth)

4708 MULTIPLE PRODUCTION OF PIONS IN HIGH ENERGY COLLISIONS FROM COSMIC RAYS AND INTERSECTING RINGS. Smorodin, Yu. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 19: No. 3, 614-625(Mar 1974). (In Russian).

Experimental data on multiple production of pions in cosmic rays with energies of 10^{11} to 10^{14} eV are summarized in terms of the model of two clusters, one fast and other slow. The pion production inclusive cross section, calculated by means of this model, for the energies 0.5-1.5 TeV are compared with the ISR experimental data. There is a quantitative agreement of all the results for positive and negative pions and for the γ quanta originated from decay of π^0 mesons. The calculations result in the scaling for production of pions related to the fast cluster as a consequence of production of clusters moving with Lorentz factors proportional to that of the incident particle while their masses and decay modes are independent of the interaction energy. Such as independence is evidently due to production of the fast cluster in fragmentation of the parton packet of the nucleon. The cosmic-ray data show that the conditions providing the observed scaling are preserved for the energies up to ~10^{14} eV. At higher energies an excitation of heavier clusters becomes essential that results in changing of the scale. (auth)

4709 MULTIREGGEON ANALYSIS OF REACTIONS pp → $pn\pi^+$ AND pp → $pp\pi^+\pi^-$ WITH ACCOUNT OF BARYON EXCHANGES. Arestov, Yu. I.; Moiseev, A. M.; Ter-Martirosyan, K. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 19: No. 3, 682-695(Mar 1974). (In Russian).

Properties of ladder graphs for the processes $pp \to pn\pi^+$ and $pp \to pp\pi^+\pi^-$ are considered in multireggeon theory using the baryon Regge trajectories. Distributions are presented in the four-momentum transfers t_i, in effective pair masses $M_{i,i+1}$ and in the particle momenta. Some theoretical spectra are compared with the experimental data at 28.5 GeV/c and particle-reggeon coupling constants are estimated. The cross sections of the reactions are calculated at 70 and 200 GeV/c. (auth)

4710 FADDEEV APPROACH TO PION PRODUCTION. Afnan, I. R.; Thomas, A. W. pp 861-864 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The Faddeev equations have had considerable success in describing three body scattering data, using quite simple two body interactions. Low energy pion deuteron production is considered in a three body model. In order to treat the process, $p + p \to \pi^+ + d$ a bootstrap model of the nucleon is used. There are two main reasons for investigating this reaction. First, there is much interest in pions as probes for nuclear structure information via such reactions as $(\pi,2N)$. Secondly, there is a chance that pions may be useful probes of the free two-nucleon force, particularly off-shell effects. The convergence of the multiple scattering series in the model was tested, and was found to be divergent. The predictions of the Koltun-Reitan method were confirmed in the calculation. (auth)

4711 SIGN OF THE $T = \frac{3}{2}$ ΣN AMPLITUDE FROM Σ^--d SCATTERING. Schick, L. H. pp 910-912 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It is shown that, in low energy Σ^-d scattering interference of the isospin $\frac{3}{2}$ Σ^-n interaction with the three-channel Σ^-p interaction, might well present a means of determining the sign of the low-energy Σ^-n amplitude. (auth)

4712 STRONG INTERACTION EFFECTS IN ANTIPROTONIC ATOMS. Barnes, P. D.; Dytman, S.; Eisenstein, R. A. pp 944-948 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Measurements of the widths and the energies of the x-ray lines from the 4f → 3d transition in antiprotonic atoms with nuclei of ^{14}N and ^{16}O are reported. Experimental results are interpreted in terms of a $\bar{p}$-nucleus optical potential. Preliminary observations of the x-ray from the 3d → 2p transition in the $\bar{p}$ – He atom are also reported. (auth)

4713 WEAK INTERACTION AND PARITY VIOLATION IN POLARIZED PROTON–PROTON SCATTERING. Simonius, M. (Eidgenoessische Technische Hochschule, Zurich). pp 249-253 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Possible direct determinations of parity violating nucleon–nucleon scattering amplitudes in polarized p–p scattering and the theoretical significance of such experiments are discussed. The primary interest lies in the possibility of distinguishing between the fundamental mechanisms invoked to explain the hadronic $\Delta I = \frac{1}{2}$ rule known under the key words "octet enhancement" and "neutral currents." (auth)

4714 LOWEST APPROXIMATION OF RELATIVISTIC NUCLEON–NUCLEON SCATTERING IN FUNCTIONAL QUANTUM THEORY. Illig, K. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 29a: No. 1, 1-16(Jan 1974).

Using a self-coupled spinor field (Fermi coupling) as a model to describe relativistic nucleon–nucleon scattering it is shown that the functional S-matrix construction for relativistic clusters in nonlinear spinor theory proposed by Stumpf reproduces in lowest order perturbation theory the result obtained by usual quantum field theoretical methods. (GE)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 4734 and 5267.

4715 (PURC-4159-53) CP VIOLATION, NEUTRAL CURRENTS, AND WEAK EQUIVALENCE. Fitch, V. L. (Princeton Univ., N. J. (USA)). 1972. Contract AT(11-1)-3072. 34p. (CONF-711220-1). Dep. NTIS $4.75.

From conference on particle physics; Irvine, California, USA (3 Dec 1971).

The review of CP violation, neutral currents, and weak equivalence covers the parameters, eta plus minus, eta naught naught, status of the Wu–Yang triangle, charge asymmetry, strangeness-changing neutral currents, and the weak equivalence principle. (JFP)

4716 SUBGROUPS OF THE SU(n) GROUP, ISOMORPHISM WITH THE SU(2) GROUP, AND TWO-DIMENSIONAL UNITARY TRANSFORMS. Bogush, A. A. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 63-68(1974). (In Russian).

Subgroups of the finite transforms of the SU(n) group, isomorphic with the SU(2) group, were isolated. Two-dimensional unitary transforms, achieving the transition from one complex vector to another in the unitary space of random dimensions n, were introduced. The concept of transforms of the subgroups introduced in the two-dimensional form guarantees the identification of that two-dimensional space in which this subgroup is determined. The possibility of introducing vector parameterization for the subgroups examined was indicated. This makes it possible during construction of the finite transforms of finite-dimension space of these subgroups to use the corresponding results for the SO(3) groups. (tr-auth)

4717 BOOTSTRAP EQUATIONS FOR ARBITRARY INTERACTION. Konopelchenko, B. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Lett. Nuovo Cim.; 9: No. 11, 456-459(16 Mar 1974).

It is shown that bootstrap equations permit conformal invariant solutions for arbitrary interaction. The convergence conditions of the skeleton-graph expansion in the case of arbitrary interaction in ν-dimensional space-time are also considered. (LBS)

4718 GENERALIZED O(1,2) EXPANSIONS OF MULTIPARTICLE AMPLITUDES. II. THE O(1,2) LAPLACE TRANSFORM. Cronström, C. (International Centre for Theoretical Physics, Trieste, Italy). Ann. Phys. (N.Y.) 78: No. 2, 340-351 (June 1973).

We extend a previous work [1] on generalized O(1,2) expansions for power-bounded multiparticle amplitudes. This extension allows one to shift the contour-integral in the O(1,2) integral representation an arbitrary but finite distance into the left half of the l-plane. The discrete terms in the representation get absorbed into the integral in this case, but instead new discrete terms appear which are of the order of magnitude $O(s^{-1})$ for large values of s. These new discrete terms disappear if the Mandelstam symmetry holds. (auth)

4719 EMBEDDING OF THE PERMUTATION GROUP OF THREE RELATIVISTIC PARTICLES INTO THE GROUP O(6) AND SYMMETRIZED COORDINATES AND WAVE FUNCTIONS. Klepikov, N. P. (Moscow State Univ.). Yadern. Fiz.; 19: No. 3, 696-698(Mar 1974). (In Russian).

Coordinates are introduced that for three relativistic particles transform the Dalitz plot into a circle with a constant phase density. Symmetrized wave functions are indicated. (auth)

4720 GENERAL PHYSICAL PRINCIPLES AND NONLINEAR GROUP REALIZATIONS. Dresden, M. (State Univ. of New York, Stony Brook). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 65-85(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

The basic question raised is the relation between group theoretical and physical notions. In particular the physical significance of the mathematical entities occurring in group representations is examined in detail. For this reason a brief outline is presented of the mathematical definitions and status of nonlinear realizations of groups. Special nonlinear realizations of the Lorentz and Poincaré groups are exhibited. The possible physical meaning of these realizations is discussed. It is shown

that there is a fundamental interpretation question involved, which indicates that the identical formalism can describe a wide variety of physical phenomena. The classical (Wigner) theory of the representations of the Poincaré group, allows the description of many-particle systems in terms of elements and operators in tensor products of Hilbert space. An appropriate adaptation of this procedure suggests that the utilization of the nonlinear realization of the Poincaré group, describes a relativistic many-particle system in interaction. General requirements such as causality are shown to be compatible with the formalism of the nonlinear realizations. (auth)

4721 ALGEBRAIC APPROACH TO $(3,\bar{3}) + (\bar{3},3) + (8,8)$ CHIRAL-SYMMETRY BREAKING. Rao, J. S.; Gupta, K. C. (Univ. of Delhi). Nucl. Phys.; B69: No. 3, 657-663(1974).

The Hamiltonian $H = H_0 + \epsilon_0 u_0 + \epsilon_8 u_8 + A\, S_{\alpha\alpha} + B\, d_{\alpha\beta\delta}\, S_{\alpha\beta}$ is examined, where u_0, u_8 belong to $(3,\bar{3}) + (\bar{3},3)$ and $S_{\alpha\alpha}$, $S_{\alpha\beta}$ belong to (8,8), following a purely algebraic approach due to Michel and Radicati and obtain $B/A = 2\sqrt{3}$ if $\epsilon_8/\epsilon_0 = -\sqrt{2}$. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 5072 and 5144.

4722 ELEMENTS OF GROUP THEORY FOR GAUGE MODELS. Gourdin, M. (Paris Univ., Orsay, France). pp 329-343 of Proceedings of the Eighth Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Orsay, France; Paris Univ. (1973).

From eighth Rencontre de Moriond; Meribel-les-Allues, France (4 Mar 1973).

The Lie algebra mechanisms used in gauge theories with Yang-Mills fields are explained together with the role of Higgs mesons. (FR)

4723 MINIMAL COUPLING AND MAGNETIC CHARGE. Combe, P. (Univ., Marseille); Richard, J. L. Physica; 71: No. 1, 66-74(1 Jan 1974).

The most general form of the lagrangian of a particle in a constant and uniform electromagnetic field is derived using group-theoretical arguments based on Levy-Leblond's approach to the lagrangian gauge problem. The so-called minimal coupling is derived. In the case of a purely magnetic field, it is shown that the principle of minimal coupling by the magnetic charge breaks down if the invariance of the equations of motion under space reflection is required. (auth)

4724 THE BARYON LADDER OF THE U(6, 6) -SYMMETRY. Drenska, S.; Ivanov, M.; Vaklev, J. (Physical Institute of the Bulgarian Academy of Scienes, Sofia, Bulgaria); Nikolov, A. Ann. Phys. (N.Y.) 79: No. 1, 99-110 (July 1973).

An unified classification of the Baryons is made with the help of the so-called Baryon ladder of U(6, 6). For this reason a complete set of commuting operators (introduced in a previous paper), including the squares of the spin and the isotopic spin, their third projections, the hypercharge, the Baryon number and so on, is used. Multiplets of a nontraditional type are obtained, which are in good agreement with the experimental situation. A Baryon mass operator is introduced; it is diagonal in the particles. With its help series of mass formulas are obtained for Baryons with spin-parity $(1/2)^+$, $(3/2)^+$, $(1/2)^-$, $3/2)^-$, (5/2) and they are in a very good agreement with the experiment. (auth)

Applications (Strong)

Refer also to abstracts 4668, 4685, and 4713.

4725 ALGEBRA OF REGGE RESIDUES AND CHIRAL SYMMETRY. Ram Mohan, L. R. (Freie Univ., Berlin). Nucl. Phys.; B72: No. 2, 201-220(1974).

The algebraic properties of isospin T_a, axial charge X_a, and Regge residues ρ, A_1, π, f are studied by means of a combination of low-energy theorems of current algebra and finite energy sum rules. The algebra of $SU(2) \times SU(2) \times O(5)$ is derived. A meson saturation scheme with π, A_1, ρ and σ mesons provides a representation of this algebra and gives couplings in good agreement with experiment. (auth)

Scattering Theory

Refer also to abstracts 4718 and 5142.

4726 (DESY-74-9) EIKONAL EXPANSION OF THE SCATTERING AMPLITUDE IN IMPACT PARAMETER REPRESENTATION. Weiss, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Mar 1974. 38p. Dep. NTIS (US Sales Only) $5.00.

An eikonal expansion method of the potential scattering transition amplitude in impact parameter representation is considered and evaluated, without approximation, through third order in the inverse momentum. A sequence of four approximations to the exact impact parameter representation is obtained which consists of the eikonal representation of Glauber and three systematic corrections to the Glauber approximation. The correction terms agree with the form conjectured by Wallace. Numerical results are given for the exponential and Yukawa potential. The sequence of eikonal amplitudes shows systematic improvement at all angles by comparison with partial wave calculations. (auth)

4727 (IFVE-STF-73-26) TOTAL CROSS-SECTION INCREASE IN THE ELASTIC SCATTERING MODEL. Arkhipov, A. A.; Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 9p. INIS.

A possible increase of total cross sections is discussed in the framework of the model, based on introducing a smooth quasi-potential. (auth)

4728 (LBL-2031) MACROCAUSALITY AND ITS ROLE IN PHYSICAL THEORIES. Stapp, H. P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 29 May 1973. Contract W-7405-eng-48. 19p. (CONF-730576-1). Dep. NTIS $4.00.

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973).

The physical meaning of the macrocausality property of scattering transition probabilities is described, and the role of this property in S-matrix theory and other physical theories is discussed. The macroscopic causality properties of theories with shadow particles are examined and are shown to contradict the general interpretational principles of quantum theory. Shadow particles were introduced to remedy the unitarity difficulties of indefinite-metric field theories. (auth)

4729 (RHEL-72-1(Vol. 1), pp 449-501) MANY-BODY PROBLEMS IN HADRON REACTIONS. Hong-Mo, C. (Rutherford High Energy Lab., Chilton, Eng.). 1972.

From fourth international conference on high energy collisions; Oxford, UK (5 Apr 1972).

The review of the many-body problem in hadron reactions covers mainly inclusive experiments. (JFP)

4730 LEVINSON'S THEOREM. Beregi, P.; Zakhar'ev, B.N.; Niyazgulov, S.A. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 4: No. 2, 217-230 (Oct 1973).

Papers in which relationships are established between the phase shifts at zero and infinite energy and the number of bound states of a system are reviewed. The cases when the two-body potential is local, nonlocal, velocity-dependent, and energy-dependent, and the scattering of charged particles are discussed. Levinson's theorem is also formulated for many-channel scattering, and for systems of three of more particles, etc. (auth)

4731 GENERALIZED JWKB APPROXIMATION FOR MULTICHANNEL SCATTERING. Johnson, B. R. (Ohio State Univ., Columbus). Chem. Phys. (Amsterdam); 2: No. 4, 381-399(Dec 1973).

The well known JWKB approximation is generalized to handle multichannel scattering problems. Included is a discussion of how the JWKB connection formulas can be applied to the multiple classical turning points which occur in the multichannel case. A new and useful form of the distorted wave transformation is derived and applied to the two state curve crossing problem. The result is a useful factorization and parameterization of the S-matrix. The parameters are evaluated approximately by a method due originally to Zener to obtain Landau–Zener type formulas. It is also shown how the equations of the impact parameter method with straight line trajectories can be derived from the generalized JWKB equations. (auth)

4732 ON THE LEFT-HAND CUT IN POTENTIAL SCATTERING. Kok, L.P.; Greben, J.M.; van der Ploeg, F.A. (Institute for Theoretical Physics, State University, P. O. Box 800, Groningen, Netherlands). Ann. Phys. (N.Y.) 79: No. 2, 386-406 (Aug 1973).

Partial wave N/D equations in potential scattering are solved for the exponential, Hulthén and Morse potentials. The driving terms are taken to be either the contributions of a finite number of Born terms or the total contributions of only the nearest singularities (first n poles). For repulsive potentials one observes ghosts, anomalous bound states or resonances if the order of approximation is small with respect to the potential strength. The origin and meaning of these unphysical phenomena are explained. For attractive potentials such anomalies occur only at very large potential strengths if at all. Input-equivalent

Bargmann potentials are employed to determine the quality and nature of the approximate N/D solutions. Rough criteria for the validity of approximations within the N/D approach are formulated. (auth)

4733 DIAGONAL STRUCTURE OF THE S-MATRIX IN THE LEE MODEL. Greenberg, O.W.; Yabuki, H. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Ann. Phys. (N.Y.) 79: No. 1, 146-170 (July 1973).

The diagonal structure of the S-matrix in the Lee model is studied. The N2θ- and N3θ-type eigenvalues are shown to factor exactly into the products of the corresponding Nθ eigenvalues, and it follows that these eigenvalues are free of production thresholds. The (implicit) eigenvalue equation for the V2θ-type eigenvalue is given, and this eigenvalue is shown to factor asymptotically into the product of the corresponding Vθ eigenvalues. These properties are conjectured to hold for Njθ- and Vjθ-type eigenvalues. It is conjectured that the two-body type eigenphase operator gives the dominant contribution to the S-matrix at high energy. (auth)

4734 O(3, 1) EXPANSION FOR ASYMPTOTICALLY GROWING AMPLITUDES. Pasupathy, J. (Tata Institute of Fundamental Research, Bombay-5, India). Ann. Phys. (N.Y.) 79: No. 1, 131-145 (July 1973).

It is shown how to expand asymptotically growing scattering amplitudes which considered as functions defined on the group O(3, 1) do not satisfy the square-integrability criterion. We discuss the cases when the subgroup chosen to be diagonal is either the rotation group or the Lorentz group O(2, 1). Application to inclusive reactions in the fragmentation and the triple Regge region is considered. There are no fixed poles at integer point representations. We comment on the relation of the present work to methods based on integral geometry. (auth)

4735 ANALYTIC PROPERTIES OF THE PARTIAL-WAVE SCATTERING AMPLITUDE IN A QUASIPOTENTIAL MODEL. Bawin, M. (Department of Physics, Indiana University, Bloomington, Indiana). Ann. Phys. (N.Y.) 77: No. 1, 431-451 (1 May 1973).

The analytic properties of the partial-wave S-matrix S(l,E) in the framework of the radial quasipotential equation in relativistic space given by Freeman and coworkers are studied. As in the nonrelativistic case, this is done by defining regular and irregular solutions to the equation, and analyzing the properties of S(l,E) by means of the corresponding properties of these solutions. For reasons connected with the uniqueness of the solution to the quasipotential equation, we have only considered analytic solutions. Our main result is that for 2 particles of mass m and center of mass energy E interacting through an analytic potential V(z) such that $|V(z)| < \lambda e^{-\mu|z|}$, S(l,E) is a meromorphic function of χ (cosh χ=E/m) in that region of the complex χ plane where $|\chi| < \mu/2$, $|\chi| > \epsilon > 0$. Poles in the upper χ plane in the region of analyticity correspond to bound states and must lie on the imaginary axis. Difficulties connected with a similar analysis in the complex l plane are briefly considered. (auth)

4736 OBTAINING REAL PARTS OF SCATTERING AMPLITUDES DIRECTLY FROM CROSS SECTION DATA USING DERIVATIVE ANALYTICITY RELATIONS. Bronzan, J. B. (National Accelerator Lab., Batavia, IL); Kane, G. L.; Sukhatme, U. P. Phys. Lett.; 49B: No. 3, 272-276(15 Apr 1974).

It is shown that one can obtain real parts of scattering amplitudes by knowing the imaginary parts at only nearby energies. This is accomplished by re-casting the dispersion integral into an equivalent form which is called a "derivative analyticity relation". Predictions are given for forward amplitudes where σ_T is measured: pp, $\bar{p}p$, $K^{\pm}p$, $\pi^{\pm}p$, γp. The real part of the elastic pp amplitude away from the forward direction at ISR energies is deduced. (auth)

4737 PROCA AND WIGNER REALIZATION FOR SPIN ONE. Boya, L. J.; Carinena, J. F. (Barcelona Univ.). J. Phys., A (London); 7: No. 3, 352-355(11 Feb 1974).

It is shown, by relating the Proca covariant amplitude and the corresponding canonical (Wigner) amplitude for massive elementary systems with spin one, how the transversality condition arises in a natural way. The connection between both realizations extends also to establish the form of the scalar product and the position operator in covariant space. (auth)

4738 MACROCAUSALITY AND ITS ROLE IN PHYSICAL THEORIES. Stapp, H. P. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 87-114(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

The physical meaning of the macrocausality property of scattering transition probabilities is described, and the role of this property in S-matrix theory and other physical theories is discussed. The macroscopic causality properties of theories with shadow particles are examined and are shown to contradict the general interpretational principles of quantum theory. Shadow particles were introduced to remedy the unitarity difficulties of indefinite-metric field theories. (auth)

4739 ASYMPTOTIC BEHAVIOR OF A NONPLANAR ORIENTABLE DUAL TWO-LOOP AMPLITUDE. Dorn, H.; Ebert, D. (Humboldt Univ., Berlin). Nucl. Phys.; B72: No. 2, 228-252(1974).

Both the s- and t-channel asymptotic behaviour of a non-planar orientable two-loop four-point amplitude are investigated. A factorized expression for the iterated pomeron singularity, contributing to the s-channel behaviour, has been obtained with an internal pomeron blob closely related to the off-shell "propagator" of Cremmer and Scherk. These results suggest an interpretation in terms of a renormalization scheme of the pomeron. For t-channel asymptotics Regge-cut behaviour arises. Remarks are also made for the corresponding six-point case. Direct expansions of all the relevant functions in terms of group parameters as well as a thorough study of Jacobi's transformation in the double parabolic limit are of crucial importance to prove these results. (auth)

4740 UNITARY AMPLITUDES WITH CUT-PLANE ANALYTICITY FROM GIVEN SCATTERING DATA. Bart, G. R. (Mayfair Coll., Chicago); Johnson, P. W.; Warnock, R. L. Nucl. Phys.; B72: No. 2, 329-358(1974).

The study of constructing the scattering amplitude for scalar particles from elastic scattering data at a given energy is continued. Here the scattering amplitude, f(z), is required to be analytic in a suitably cut z-plane; (z is the cosine of the scattering angle). It is found that, in the elastic domain, the unitarity constraint is satisfied by a continuum of amplitudes, all corresponding to the same elastic scattering data. This continuum ambiguity in determination of f(z), which was noted earlier in formulations based on a smaller domain of analyticity, is associated with lack of knowledge of the contribution to unitarity from inelastic channels. The problem of incorporating smooth energy dependence in the determination of the scattering amplitude over some range of energy is discussed, and it is shown that, under certain restrictions on the scattering data, there is a continuum of amplitudes having smooth energy dependence. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

4741 NEW FEATURES OF THE VORTEX-RING TRANSITION. Zoll, R.; Schwarz, K.W. (Department of Physics and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. Lett. 31: No. 24, 1440-1443 (10 Dec 1973).

A novel experimental technique has been used to study how charge carriers in superfluid helium produce quantized vortex rings. Measurements taken over a wide range of temperature, pressure, and He^3 impurity concentration reveal several new features of the vortex-ring transition, and indicate that some commonly made assumptions about the nature of the transition may need revision. (auth)

4742 FINITE-GEOMETRY EFFECTS AND ONSET OF SUPERFLUIDITY IN ^{3}He-^{4}He MIXTURES NEAR T_λ. Thomlinson, W. C.; Ihas, G. G.; Pobell, F. (Institut für Festkörperforschung, Kernforschungsanlage, 517). Phys. Rev. Lett. 31: No. 21, 1284-1287 (19 Nov 1973).

The amplitude and velocity of second sound near T_λ and the onset temperature $T_0(X)$ for superfluidity have been measured for ^{3}He-^{4}He mixtures in resonators equipped with superleak transducers. The reduced temperature $\epsilon_0 = 1 - T_0(X)/T_\lambda(X)$ and the quantity $l\rho_s/T$ at ϵ_0 vary by factors of about 6 for X = 0 to 0.4. The exponents λ' for $\epsilon_0 = (d/d^*)^{-\lambda'}$ and ν' for the onset length $l = l^*\epsilon^{-\nu'}$ are independent of X to within $\pm 3\%$. Contrasting with this behavior is a 20% change of the effective exponent ζ of $\rho_s/\rho = k\epsilon^\zeta$. (auth)

4743 SOUNDLIKE COLLECTIVE EXCITATIONS IN SUPERFLUID ^{3}He. Wölfle, P. (Max-Planck-Institut für Physik and Astrophysik, Munich, Germany). Phys. Rev. Lett. 31: No. 24, 1437-1440 (10 Dec 1973).

I discuss soundlike collective excitations in anisotropic superfluid Fermi liquids in both the collisionless and the hydrodynamic regimes. Expressions for the velocities of zero, first, second, and fourth sound are derived in terms of the Landau parameters of the normal state. The second- and fourth-sound velocities are found to vary appreciably with orientation. (auth)

4744 HEAT CAPACITY OF MULTILAYER He^4 ON GRAPHITE. Bretz, M. (University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 31: No. 24, 1447-1450 (10 Dec 1973).

Helium films are explored in the temperature range 1-2.8 K for thicknesses of 3-11 atomic layers. Sharp heat-capacity peaks for the thinnest films appear to indicate melting of the second-layer solid. Thicker films display coverage-dependent truncations of the λ-point specific-heat anomaly, and cell thermal conductivity shows abrupt changes near these truncation points. Comparison with mass-flow measurements leads to the discussion of a possible intermediate superfluid phase. (auth)

4745 SUPERFLUID FRACTION IN THIN HELIUM FILMS. Chester, M. (School of Mathematical and Physical Sciences, University of Sussex, Falmer, Brighton, England); Yang, L.C. Phys. Rev. Lett. 31: No. 23, 1377-1380 (3 Dec 1973)

A shear-mode quartz-crystal microbalance measures only the nonsuperfluid component of the helium film adsorbed on it. From this effect detailed curves of the superfluid content in such films are obtained as functions of the total film mass adsorbed per unit area and of temperature. Besides the characteristic linear growth region of superfluid with thickness, these curves reveal the quantitative details of the onset region. Our results are presented together with some characteristic helium parameters deduced from them. (auth)

4746 OBSERVATION OF TEMPERATURE OSCILLATIONS IN QUASI-ISOTHERMAL SUPERFLUID FILM OSCILLATIONS. Hallock, R.B.; Flint, E.B. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. Lett. 31: No. 23, 1383-1386 (3 Dec 1973)

We report the first observations of the small temperature oscillations which accompany the nearly isothermal oscillations in the levels of two reservoirs of He II which are connected only by the mobile superfluid film. We show that our experimental results are in accord with a nearly isothermal approximation to the general theory first elucidated by Robinson for capillary flow. The amplitude of the temperature oscillations is in agreement with expectations based on the measured thermal conductance and time constant for our apparatus. (auth)

4747 CRITICAL VELOCITIES FOR SUPERFLUID-HELIUM FLOW THROUGH A SMALL HOLE. Hulin, J.P.; D'Humieres, D.; Perrin, B.; Libchaber, A. (Groupe de Physique des Solides, Ecole Normale Supérieure, 24, rue Lhomond, Paris 5, France). Phys. Rev. A 9: No. 2, 885-892 (Feb 1974).

An experiment study of the flow of superfluid helium through a small hole (6-10 μ diameter) between 0.3 and 1.7 °K is reported. The hole is inside a small volume protected by a porous filter. Two distinct stable-flow regimes are observed: a fast velocity (up to 1000 cm/sec) which decreases as $(\rho_s/\rho T)^{1/2}$ between 0.5 and 1.7 °K (in this case the dissipation mechanism is probably the thermal excitation of vortex rings), and a slow temperature-independent velocity which increases as the square root of the chemical-potential difference, for which vortex emission from a source filament pinned in the flow is given as a model. (auth)

4748 GROUND-STATE ENERGY OF A DILUTE FERMI GAS. Bishop, R.F. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 77: No. 1, 106-138 (1 May 1973).

A large assembly of identical fermions interacting via a repulsive two-body potential is considered, and a series expression for the ground-state energy is developed. All terms preceding those dependent on parameters of three (or more) -particle scattering, are calculated. For the particular case of a hard-core interaction of diameter a, the ground-state energy is developed as $\Delta E = Ic + Jc^2 + Kc^3 + Lc^4 \ln c + O(c^4)$, where $c \equiv k_F a$ and k_F is the Fermi wavenumber of the system; and the coefficients I, J, K, and L are calculated. Two methods, using Goldstone and Feynman diagrams respectively, are developed simultaneously and are shown to form complementary techniques. The Feynman technique has not previously been applied to this problem beyond the term of $O(c^2)$. Some formal properties of the exact Bethe-Goldstone equation in the case of the hard-core interaction, are developed in an appendix. (auth)

4749 ATTENUATION OF ZERO SOUND AND THE SEVERAL LOW-TEMPERATURE PHASES OF LIQUID ^{3}He. Lawson, D. T.; Gully, W. J.; Goldstein, S.; Richardson, R. C.; Lee, D. M. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 15: No. 1-2, 169-210(Apr 1974).

Measurements of the attenuation of 10-MHz compressional waves in liquid ^{3}He along the melting curve reveal a sharp peak at the A transition (2.7 mK). In a magnetic field this feature splits into two attenuation peaks, separated by a temperature difference proportional to H. The shapes of these peaks, though changing markedly between H = 0 and 1 kOe, are all consistent with the A phase being an anisotropic BCS-type superfluid and inconsistent with an isotropic gap model. Field-dependent time variations in the attenuation and various transient effects provide further clues to the nature of this phase. A third sharp attenuation peak—at the B transition ($\lesssim$2 mK)—possibly represents scattering from a liquid–liquid interface. It is, in any event, consistent with an isotropic superfluid B phase. Velocity changes have been observed at both A and B transitions, indicating velocities in the B phase significantly less than that of first sound at the same pressure. (auth)

4750 OBSERVATION OF MULTIPLE VINEN STATES IN He II COUNTERFLOW. Childers, R. K.; Tough, J. T. (Ohio State Univ., Columbus). J. Low Temp. Phys.; 15: No. 1-2, 53-62(Apr 1974).

In an extensive investigation of the thermal resistance of He II contained in both metal and glass capillary tubes, a curious and highly reproducible fine structure heretofore not reported was observed. This fine structure, exhibited only in the metal tubes, can be satisfactorily accounted for by assuming the existence of two distinct distributions of vorticity, each described by the Vinen theory. The significant difference in the thermal resistance between glass and metal tubes has serious implications toward critical velocity measurements. (auth)

4751 OBSERVATION OF A NEW FLOW STATE IN He II COUNTERFLOW. Childers, R. K.; Tough, J. T. (Ohio State Univ., Columbus). J. Low Temp. Phys.; 15: No. 1-2, 63-70 (Apr 1974).

The observation of a new flow state for He II in thermal counterflow is reported. The new state has been observed only in metal flow tubes, experiments with similar size glass tubes showing no trace of it whatever. Furthermore, the new state exists only over a finite range of heat currents and can be induced from the laminar flow region only by the application of a mechanical shock to the cryostat. For certain temperatures the new state can couple with the Vinen state of mutual friction, producing sustained oscillations in the temperature difference between the tube ends. It is speculated that this new state is due to a type of flow in the normal fluid which has recently been proposed for classical fluids, spiral flow. (auth)

4752 SPECIFIC HEAT OF ^{3}He–^{4}He MIXTURES IN VYCOR GLASS. Eggington, M. A.; Moore, M. A. (Univ. of Sussex, Brighton, Eng.). J. Low Temp. Phys.; 15: No. 1-2, 99-110(Apr 1974).

The specific heat of a ^{3}He–^{4}He mixture filling a narrow pore is calculated in the temperature range 0.5 to 1 K, including the effect of van der Waals forces due to the walls, and is found to be compatible with the enhancement over the bulk liquid value experimentally observed for mixtures in Vycor glass. (auth)

4753 SCATTERING AND BINDING OF ROTONS. Roberts, P. H.; Donnelly, R. J. (Niels Bohr Inst., Copenhagen). J. Low Temp. Phys.; 15: No. 1-2, 1-27(Apr 1974).

The interaction of rotons is studied by a direct examination of their orbital dynamics. It is found that upon representing rotons as point dipoles in the superfluid, obeying the Landau dispersion relation, negative energy states occur, some of which are stable and some unstable. The binding energy and effective mass of these states are found, but are too large to agree with experiment. Improvements in the Hamiltonian are explored which recognize the actual dispersion curve as well as higher moments in the interaction. Both modifications lead to binding energy and effective mass in better agreement with experiment. Scattering is also examined, and one finds that a representative roton–roton cross section may be obtained in the dipole approximation, again using Landau dispersion. The scattering cross section is shown to be in satisfactory agreement with neutron linewidths in the roton-dominated region, as well as the roton contribution to the shear viscosity. (auth)

4754 QUANTUM FLUID–SOLID TRANSITION IN A SIMPLE VARIATIONAL APPROACH. de Llano, M.; Ramirez, S. (International Center for Theoretical Physics, Trieste, Italy). Ann. Phys. (N.Y.) 79: No. 1, 186-200 (July 1973).

A determinant (permanent) of plane waves for N fermions (bosons) in their lowest-energy state, and a determinant (permanent) of spatially-localized, nonoverlapping, single-particle functions are used to determine conditions on the short-ranged, square-well repulsive plus Yukawa attractive, two-body potential for which the spatially homogeneous or periodic particle-density states are energetically preferred. A considerable region in the coupling parameter–density plane is found where "crystalline" solutions are preferred. In particular, for purely repulsive forces, the low-density region for which the "fluid" solution is lowest shrinks to zero in the limit of infinitely repulsive cores, but faster for bosons than fermions. Inclusion of attractive forces is seen not to alter qualitatively the main results. (auth)

4755 EXPERIMENTAL TEST OF A NEW MECHANISM OF DISSIPATION IN ACCELERATED SUPERFLUID FILM FLOW. Hallock, R. B.; Flint, E. B. (Univ. of Massachusetts, Amherst). Phys. Lett.; 47A: No. 5, 417-418(22 Apr 1974).

The damping, α, and the frequency, ω, of superfluid film oscillations were measured under quasi-isothermal conditions for a variety of geometries. Experimental values for α are found to be in quantitative agreement with the Robinson theory as applied to film flow. This suggests that the damping mechanism proposed recently by Calvani, Greulich and Maraviglia does not provide a major contribution to the dissipation observed. (auth)

4756 POSSIBLE UNIFICATION OF THE FEYNMAN AND ILF CRITICAL VELOCITY THEORIES. Weaver, J. C. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.; 47A: No. 5, 379-380(22 Apr 1974).

A model is proposed to explain superfluid helium decay rates and critical velocities in channels over the entire range $0 \leq T \lesssim T_\lambda$. Included is a prediction, for the first time, of the recently observed behavior that the same decay rate can occur for different initial velocities. (auth)

4757 SUPERFLUID FRACTION NEAR T_λ IN ^{3}He–^{4}He MIXTURES. Ikushima, A.; Terui, G. (Tokyo Univ.). Phys. Lett.; 47A: No. 5, 387-388(22 Apr 1974).

The superfluid fraction near T_λ in ^{3}He–^{4}He mixtures was determined from the measured second-sound velocity as a function of ^{3}He mole fraction ranging from 0 to 0.395. (auth)

4758 DYNAMIC CRITICAL EXPONENT OF A BOSE SYSTEM TO O(1/n). Kondor, I.; Szepfalusy, P. (Inst. for Theoretical Physics, Budapest). Phys. Lett.; 47A: No. 5, 393-394 (22 Apr 1974).

The dynamic critical exponent of an n-component Bose system is calculated by the 1/n expansion technique to order 1/n in $2 < d < 4$ dimensions. (auth)

4759 CALCULATION OF THE ENERGY SPECTRUM FOR A ZERO-TEMPERATURE BOSE-SYSTEM BY MEANS OF THE DECOUPLED BY PERTURBATION THEORY CHAIN OF GREEN'S FUNCTIONS. Meyer, L. Acta Phys. Pol.; A45: No. 3, 313-342(Mar 1974). (In German)

A theory was developed which permits the equilibrium system for the Green functions of a condensed Bose system to be decoupled so consistently that a development of the mass operators according to Fourier transformation powers of the interaction potential is obtained. If this development is decomposed by the linear term the known Bogoliubov approximation is obtained. The mass operations up to the quadratic term were calculated and the results for a model Hamilton operator, which in place of the complete interaction considers only the condensate particle operators containing interaction terms, and a δ-shaped interaction potential for T = 0°K were evaluated and discussed. (tr-auth)

4760 THERMAL EFFECTS IN ROTATING SUPERFLUID HELIUM DUE TO VORTEX MOTION. Vidal, F. (Ecole Normale Physique Superieure, Paris). Compt. Rend., Ser. A, B; 277: No. 24, 723-726(17 Dec 1973). (In French).

It is shown that the presence of an entropy flux associated with the motion of vortices in rotating He II is the reason for the observed reduction in the velocity of second sound. It is suggested that the entropy carried by the vortex is that of normal fluid dragged around by its rotation. (FR)

Superconductivity

Refer also to abstract 3779.

4761 (N-73-29726) HIGH-TEMPERATURE SUPERCONDUCTOR Nb_3Ga. Vieland, L. J.; Wicklund, A. W. (RCA Labs., Princeton, N. J. (USA)). Aug 1973. Contract NAS3-16060. 48p. (NASA-CR-2308; PRRL-73-CR-18). NTIS $3.00.

The discovery of superconductivity at 20.3°K in the Nb–Ga system by applying chemical vapor deposition (CVD) techniques to the materials preparation problem is reported. Films on ceramic substrates have been grown with superconducting onsets of up to 20.3°K. Critical fields at 4.2°K in excess of 300 kG and alpha's of 1100,000 T-A/sq cm have been obtained. The results confirm that the outstanding properties of Nb–Ga are due to an equilibrium configuration of the system, namely, the stoichiometric A-15 compound Nb_3Ga, which is stable at relatively low temperatures. Practical materials preparation problems center on the codeposition of an adjacent Nb_3Ga_2 phase and the requirement that the deposition temperature be low. Some ternary alloys were also prepared, with part of the Ga replaced by Sn, Sb, Al, or Ge. (auth)

4762 SUM RULES FOR THE SURFACE IMPEDANCE OF METALS. Brändli, G. (Laboratory of Applied Physics and Measuring Techniques, BBC Brown, Boveri and Company, Limited, 5401 Baden, Switzerland). Phys. Rev. B 9: No. 1, 342-343 (1 Jan 1974).

A previously found sum rule for the surface resistance of superconductors in the far infrared is generalized and proved by simpler arguments. (auth)

4763 NUCLEAR SPIN DIFFUSION AND ITS THERMODYNAMIC QUENCHING IN THE FIELD GRADIENTS OF A TYPE-II SUPERCONDUCTOR. Genack, A.Z.; Redfield, A.G. (Columbia University, New York, New York 10027). Phys. Rev. Lett. 31: No. 19, 1204-1207 (5 Nov 1973).

We have observed anomalously rapidly relaxation of dipole–dipole energy in mixed-state superconducting vanadium. We show that spin diffusion driven by an inhomogeneous magnetic field uses spin–spin energy as a heat sink. Coupled differential equations are proposed for magnetization and spin–spin energy, and the diffusion coefficient is inferred from our measurements. It is concluded that spin diffusion cannot be a relaxation mechanism for magnetization in the mixed state, as previously assumed. (auth)

4764 PHONON SOFTENING IN LANTHANUM UNDER PRESSURE. Wühl, H.; Eichler, A.; Wittig, J. (Institut für Festkörperforschung der Kernforschungsanlage Jülich, D-517 Jülich, Germany). Phys. Rev. Lett. 31: No. 23, 1393-1396 (3 Dec 1973).

Superconducting tunneling experiments on double-hexagonal close-packed La show that the ratio $2\Delta_0/kT_c$ increases with pressure. The low-frequency part of the phonon density of states shifts to lower energies. Phonon softening is thus, at least partially, responsible for the strong increase of the superconducting T_c with pressure. (auth)

4765 ANOMALOUS NUCLEAR SPIN-LATTICE RELAXATION IN SUPERCONDUCTING AlMn. Daugherty, M.; Parvin, K.; MacLaughlin, D.E. (Department of Physics, University of California, Riverside, California 92502). Phys. Rev. Lett. 31: No. 25, 1485-1487 (17 Dec 1973).

Measured Al^{27} nuclear spin–lattice relaxation times in superconducting AlMn alloys deviate from the law of corresponding states predicted from the theory of pair weakening by nonmagnetic resonant 3d impurity states. The results indicate appreciable broadening of the superconducting quasiparticle excitation spectrum by the Mn impurities. (auth)

4766 VOLUME DEPENDENCE OF THE ELECTRON–PHONON MASS ENHANCEMENT AND THE PRESSURE DEPENDENCE OF Tc IN TRANSITION METALS. Ratti, V. K.; Evans, R.; Gyorffy, B. L. (Univ. of Bristol, Eng.). J. Phys., F (London); 4: No. 3, 371-379(Mar 1974).

The volume dependence of the width of the d "resonance" in some transition metals is calculated using the Mattheiss prescription for the crystalline electron–ion potential. This information is then used in a single scatterer approximation to estimate the variation of η, the electronic part of the electron–phonon mass enhancement, with volume. The results agree well with empirical analyses of the pressure dependence of the superconducting transition temperature in transition metals. The volume dependence of the width of the d band is also discussed. (auth)

4767 SUPERCONDUCTIVITY AND MACROSCOPIC QUANTUM PHENOMENA. Nee, T.W.; Rogovin, D.; Scully, M.O. (Department of Physics and Optical Science Center, University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N.Y.) 77: No. 1, 79-105 (1 May 1973).

The unique coherence properties displayed by superconductors has often lead to the observation that the entire system behaves like a single quantum particle of mass 2m and charge 2e. In this paper we establish the conditions under which this macroscopic quantum assertion is valid within the framework of the microscopic theory of superconductivity. (auth)

4768 CRITICAL THICKNESSES FOR THE TRANSITION FROM INTERMEDIATE- TO MIXED-STATE BEHAVIOR IN SUPERCONDUCTING THIN FILMS OF Pb, Sn, AND In. Dolan, G. J. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 15: No. 1-2, 133-160(Apr 1974).

Recent direct observations of the magnetic structure in thin films of Pb, Sn, and In are discussed relative to resistance measurements on the same films and to earlier experimental and theoretical work on thin films. Comparison to the theoretical results of Maki and Lasher is made and it is found that these results predict reasonably accurately the critical thickness separating intermediate- and mixed-state behavior in the thin films studied. This implies that the critical thickness has been overestimated in earlier work on similar films. It is suggested that this accounts, in part, for the high values obtained for the pure, bulk Ginzburg–Landau parameter in those experiments. (auth)

4769 DIRECT OBSERVATIONS OF THE MAGNETIC STRUCTURE IN THIN FILMS OF Pb, Sn, AND In. Dolan, G. J. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 15: No. 1-2, 111-132(Apr 1974).

Direct, high-resolution observations of magnetic structures in evaporated films of the type I superconductors lead, tin, and indium are presented for a range of applied fields. The films are polycrystalline and range in thickness from 200 to 20,000 Å. The transition from the intermediate state to the mixed state is observed. The observation of the single-fluxoid vortex mixed state in the thin films with Ginzburg–Landau parameter $\kappa < 1/\sqrt{2}$ confirms theoretical prediction by Tinkham, Maki, and Lasher. No ordered array of vortices is observed and this is shown to be caused by the effects of the grain boundaries on the magnetic structures. (auth)

4770 GIANT THERMOELECTRIC POWER OF $(La,Ce)Al_2$. Moeser, J. H.; Steglich, F.; Minnigerode, G. v. (Univ., Cologne). J. Low Tem. Phys.; 15: No. 1-2, 91-98(Apr 1974).

The thermoelectric power of $LaAl_2$ and of $(La,Ce)Al_2$ alloys was measured between 0.3 and 9 K. A large, negative peak caused by the Kondo effect of the Ce impurities has been observed at about 1 K. The peak value of about $-16\ \mu V/K$ obtained from the Nordheim–Gorter rule suggests $V = +0.05$ eV and $J = -0.11$ eV for the interaction energies of the potential and exchange scattering of the conduction electrons by the Ce impurities. (auth)

4771 MAGNETOTHERMAL PROPERTIES OF Nb–W, Nb–Ti, AND Nb–Mo ALLOYS IN THE MIXED STATE. Subramanyam, S. V.; Chopra, V. (Oxford Univ.). J. Low Temp. Phys.; 15: No. 1-2, 71-77(Apr 1974).

Flux jumps and magnetothermal effects in single crystals of niobium and niobium doped with tungsten, titanium, and molybdenum have been studied in the mixed state in a vacuum calorimeter. It is observed that (a) the field at which the first flux jump occurs is independent of the sweep rate at low sweep rates (1 to 10 Oe sec) but increases sharply at higher sweep rates (~100 Oe/sec) of the magnetic field, (b) the heat evolved during the flux jump becomes larger as the sample's temperature is reduced, (c) the temperature fluctuations of the type observed by Zebouni et al. and Levy et al. are evidently due to the imperfect adiabatic conditions of experiments, and (d) the interval between the successive flux jumps is in good agreement with that expected from the critical state model of Swartz and Bean. (auth)

4772 PATTERN OF FLUX TUBES IN SUPERCONDUCTING LEAD FILMS. Huebener, R. P.; Kampwirth, R. T. (Argonne National Lab., IL). J. Low Temp. Phys.; 15: No. 1-2, 47-52 (Apr 1974).

At low magnetic fields the intermediate-state structure of type I superconducting films can consist of multiquantum flux tubes arranged in an ordered or disordered configuration. The number of flux tubes in small, rectangular, lead films of 6 to 8 μm thickness were studied as a function of the magnetic field applied perpendicular to the films, using a high-resolution magnetooptical method. In order to facilitate the establishment of the equilibrium flux distribution and to minimize the influence of the Gibbs free energy barrier against magnetic flux penetration, the specimens were cooled at constant field from above T_c to 4.2 K. From the results the average flux tube diameter was calculated using flux conservation. The flux tube diameter was found to be larger by a factor of 2 to 3 than the value expected from the Goren–Tinkham model. (auth)

4773 STRUCTURE IN SUPERCONDUCTING ALUMINUM TUNNEL JUNCTION CHARACTERISTICS AT $eV = 4\Delta$. Day, W. (Cambridge Univ., Eng.). J. Phys., F (London); 4: No. 3, 449-457(Mar 1974).

Structure observed in the characteristics of superconducting aluminium tunnel junctions is reported. An explanation based on the ability of quasiparticles of energy greater than 3Δ to create extra quasiparticles on "relaxing" towards the gap edge is shown to give quite good agreement to the form and magnitude of the observed structure. (auth)

4774 SHAPE EFFECTS ON THE MAGNETIZATION OF SUPERCONDUCTING LEAD AT 4.2°K. Provost, J.; Paumier, E.; Fortini, A. (Univ. of Caen, France). J. Phys., F (London); 4: No. 3, 439-448(Mar 1974).

Magnetization measurements performed on lead samples at 4.2°K show how the position of maximum magnetization and the hysteretic magnetic behavior are related to shape effects. It is possible to obtain reversible or irreversible magnetization curves by modifying the sample shape. These curves are in agreement with the two stage flux penetration process into cylinders and discs already studied by other authors and recently discussed by the present authors elsewhere. From this discussion, a simple model using conformal mapping leads to a formula giving the applied field at which the second stage occurs as a function of thickness over diameter ratio. The results are in good agreement with experimental values for discs and with a computation performed by other authors. Magnetization curves of altered spheres present interesting features which seem unknown in the literature and which may be roughly interpreted using the same ideas. (auth)

4775 CALCULATION OF THE ELECTRONIC THERMAL CONDUCTIVITY OF SUPERCONDUCTING ALLOYS WITH LOCAL STATES WITHIN THE GAP. Leon, B.; Nagi, A. D. S. (Univ. of Waterloo, Ont.). J. Phys., F (London); 4: No. 2, L13-L15(Feb 1974).

Calculations of the electronic thermal conductivity of a superconductor with magnetic impurities are based on the Shiba–Rusinov model. Significant deviations from the theoretical results of Ambegaokar and Griffin are found. However, in general, the experimental results of Bjerkaas et al. (Phys. Rev.; B5: 854(1972)) on In–Mn are not understood. (auth)

4776 HIGH ENERGY DENSITY OF STATES IN A SUPERCONDUCTING THIN FILM IN THE MIXED STATE. Saffin, R. F.; Watts-Tobin, R. J. (Univ. of Lancaster, Eng.). J. Phys., F (London); 4: No. 2, 268-279(Feb 1974).

The density of states is calculated by adapting a method used for bulk pure material by Cyrot (Phys. kondens. Mater.; 3: 374 (1965)) to take account of the altered current geometry and the effect of a finite electronic mean free path. The results should be valid for an extreme type-II situation at low temperature near the energy gap of the field free system. They show significant differences between the pure and dirty limits. (auth)

4777 LATTICE THERMAL CONDUCTIVITY OF SUPERCONDUCTING Nb–Mo AND Nb–Ta ALLOYS BELOW 1°K. Ikebe, M.; Kobayashi, N.; Muto, Y. (Tohoku Univ., Sendai). Phys. Lett.; 47A: No. 4, 277-278(8 Apr 1974).

The phonon scattering by dislocations is enhanced in Nb–Ta compared with Nb–Mo. The mass difference between Nb and Ta is indicated to be responsible for the enhancement. (auth)

4778 ELECTRON SPIN RESONANCE IN SUPERCONDUCTORS. Orbach, R. (Tel Aviv Univ., Israel). Phys. Lett.; 47A: No. 4, 281-282(8 Apr 1974).

The internal field distribution in type-II superconductors substantially alters the electron spin resonance g value and line shape. The resulting changes can be used to determine both the width and approximate shape of the internal field distribution. (auth)

4779 POSSIBILITY OF SUPERCONDUCTIVITY IN RAPIDLY QUENCHED SILICON. Tanaka, K. (Louisiana State Univ., Baton Rouge). Phys. Lett.; 47A: No. 4, 297-298(8 Apr 1974).

The symmetric negative conductance spike structures at non-zero bias voltages were observed in Si-Si point contact junctions. This observation will be understood in terms of the characteristics of a network of micro-Josephson junctions of ultrarapidly quenched granules of Si. (auth)

4780 SUPERCONDUCTING PROPERTIES OF A POWDER ROLLED COMPOSITE TAPE CONTAINING Nb_3Sn FILAMENTS. Pickus, M. R. (Univ. of California, Berkeley); Hemachalam, K.; Babu, B. N. P. Mater. Sci. Eng.; 14: 265-270(1974).

The morphological control and superconducting properties of a composite tape containing Nb_3Sn filaments made by a new powder metallurgy process are reported. Critical temperatures were in the range of from 18.1 to 18.5°K. Through procedural improvements, overall current densities up to 7×10^4 A/cm^2 in a pulsed field of 100 kG were realized. (6 fig) (auth)

4781 BAECKLUND TRANSFORMATIONS AND THE INVERSE METHOD. Chu, F. Y. F.; Scott, A. C. (Univ. of Wisconsin, Madison). Phys. Lett.; 47A: No. 4, 303-304(8 Apr 1974).

For several partial differential equations with important physical applications an exact correspondence is shown between the equations of the Bäcklund transformation and the linear equations of the inverse scattering method. (auth)

4782 FLUX VORTEX PINNING IN A SIMPLE MODEL SYSTEM. Appleyard, J. R.; Evetts, J. E.; Campbell, A. M. (Cambridge Univ., Eng.). Solid State Commun.; 14: No. 7, 567-570 (1 Apr 1974).

Results of numerical calculations of flux vortex pinning by random one and two dimensional arrays of identical pinning centres are reported. Three different methods for determining the critical state flux gradient are described and the critical state concept is shown to break down for samples smaller than a certain size. (auth)

4783 POWER FROM PHONON FLUORESCENCE IN SUPERCONDUCTORS. D'Ippolito, J. P.; Bron, W. E. (Univ. of Indiana, Bloomington). Phys. Lett.; 47A: No. 4, 309-310(8 Apr 1974).

A vibronic sideband spectrometer is used to detect phonons generated from phonon fluorescence in superconductors. Although previously projected phonon powers are just within the minimum detectivity, no sideband signals were observed. An interpretation of this result is given. (auth)

4784 EFFECT OF CRYSTAL LATTICE DISTORTIONS ON TEMPERATURE OF INDIUM SUPERCONDUCTING TRANSITION. Lazareva, M. B.; Starodubov, Ya. D. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 318-321(Feb 1974). (In Russian).

The effect of the comparison degree and rate of deformation in polycrystalline indium (99.996%) at low temperature was studied as applied to the temperature of superconducting transition T_k. It is shown that with a rise in the rate of deformation T_k shifts towards the region of higher temperatures (maximum shift reaches 0-2°) and the transition interval width decreases, which is connected with an increase in structural homogeneity of rolled metal. A drop in the rolling rate results in creation of greater crystal lattice distortions and in greater shift of T_k towards higher temperatures. (auth)

4785 PEAK EFFECT IN SUPERCONDUCTING NIOBIUM, INDUCED BY NEUTRON IRRADIATION. van der Klein, C. A. M.; Kes, P. H.; de Klerk, D. (Kamerlingh Onnes Laboratorium, Leiden). Phil. Mag.; 29: No. 3, 559-569(Mar 1974).

Neutron irradiation at reactor ambient temperature gave rise to a peak in the magnetization curve of superconducting niobium near the upper critical field H_{c_2}. It was correlated to a maximum in the critical current density J_c and it was referred to as the "peak effect". The magnitude depended strongly on the irradiation dose. The peak effect could be explained qualitatively by a theory proposed by Pippard (Pippard, A. B., 1969, Phil. Mag., 19, 217) but quantitatively the agreement was not very good. A modification of Pippard's theory in which the pinning is assumed to be caused by point defects did not give any improvement, but a modification introduced by Campbell and Evetts, (Campbell, A. M., Evetts, J. E., 1972, Adv. Phys., 21, 199) based on pinning by line defects, led to results in very close agreement with the experimental data. (auth)

4786 INFLUENCE OF PLASTIC DEFORMATION ON THE PEAK EFFECT IN A TYPE II SUPERCONDUCTOR. Osborne, K. E. (Univ. of Manchester, Eng.); Kramer, E. J. Phil. Mag.; 29: No. 3, 685-694(Mar 1974).

It was shown that the peak effect, a peak in the curve of critical current (J_c) versus magnetic field (H), was due to the existence of a narrow peak in the pinning force density F_p just below Hc_2. The J_c of a Nb-Ta alloy, which was progressively deformed by rolling to greater plastic strain, was measured as a function of H. It was observed that plastic deformation shifted the peak in F_p to lower reduced field h, broadened it and increased it in height without markedly increasing F_p on the high-h side of the peak. The broadening of the peak in $F_p(h)$ with deformation gradually transformed the peak in $J_c(h)$ into a plateau, and finally $J_c(h)$ became a monotonically decreasing function of h. The results were in quantitative agreement with the predictions of a recent model of flux pinning in hard superconductors. It appeared certain that the peak in $F_p(h)$ in materials which exhibit the peak effect was caused by the same mechanism that caused the peak in $F_p(h)$ at $h \simeq 0.3$ to 0.5 in commercial superconductors. (auth)

4787 SUPERCONDUCTING MATERIALS RESEARCH. Evetts, J. E.; Martin, P. J. Metal Sci. J.; 7: 179-184(Sep 1973).

Assessment is made of the present status and trends in superconducting materials research. A review of the fundamental principles determining the behavior of superconducting materials is followed by a discussion of some of the research problems specific to commercial alloy design and production. (IAA)

4788 PRESSURE-INDUCED SEMICONDUCTOR-METAL TRANSITIONS IN AMORPHOUS Si AND Ge. Shimomura, O. (Tokyo Univ.); Minomura, S.; Sakai, N.; Asaumi, K.; Tamura, K.; Fukushima, J.; Endo, H. Phil. Mag.; 29: No. 3, 547-558(Mar 1974).

A pressure-induced semiconductor-metal transition accompanied by a sharp resistance drop with a factor of approximately 10^{-6} was found for amorphous Si at 100 kbar and amorphous Ge at 60 kbar. The transition in Si was a reversible process between amorphous semiconductor and amorphous metal, while that in Ge was an irreversible process with crystallization into a diamond-type structure. The pressure-induced metallic character in amorphous Si and Ge was demonstrated by superconductivity at low temperatures. The metallic conduction was believed to be due to structural modifications which remain amorphous. (auth)

4789 SURFACE RESISTANCE OF SUPERCONDUCTORS. Halbritter, R. (Univ., Karlsruhe, Ger.). Z. Phys.; 266: No. 3, 209-217(Jan 1974).

In principle, the surface resistance of superconductors for RF can be calculated within the framework of the BCS-theory. However, even in the simplest case (low rf field strengths and Meissner phase), the theory yields complicated expressions, which need a computer for solving; the results are shown in graphs. To avoid the use of these complicated expressions, these numerical results are discussed in a model which allows an understanding of the unusual dependencies on the material parameters of superconductors. The theoretical results are compared with new experiments on Nb and on alloys, showing that the surface resistance of superconductors give additional information on the superconducting material in the penetration region. (GE)

4790 CONDUCTIVITY OF SUPERCONDUCTORS OF THE SECOND KIND NEAR THE CRITICAL FIELD H_{c_2} FOR ARBITRARY FREE PATHS. Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 3, 1100-1109(Mar 1974). (In Russian).

An expression for the conductivity of superconductors near the critical field strength H_{c_2} is obtained for arbitrary mean free paths and paramagnetic impurity concentrations. The limiting cases of small mean free paths and also the case of low temperatures with a large mean free path are investigated. (auth)

4791 THEORY OF INHOMOGENEOUS TUNNEL JUNCTIONS. Kulik, I. O.; Mitsai, Yu. N.; Omel'yanchuk, A. N. (Physical Technical Inst. of High Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 3, 1051-1066(Mar 1974). (In Russian).

A microscopic theory of tunnel phenomena is developed for inhomogeneous barriers. As a limiting case "point" junctions of the tunnel type or a set of such junctions are considered in the theory. It is shown that a tunnel current from two apertures oscillates as a function of voltage with a period which is inversely proportional to the distance between the apertures. This is due to interference phenomena on tunneling. The oscillations are a macroscopic phenomenon and possess a large period. Other forms of inhomogeneous barriers in both the normal and superconducting states are studied. Components of the quasiparticle and pair current (Josephson current) are calculated. (auth)

4792 EFFECT OF IMPURITIES ON VARIATION OF THE MECHANICAL PROPERTIES OF METALS IN A SUPERCONDUCTING TRANSITION. Bar'yakhtar, V. G.; Druinskii, E. I.; Fal'ko, I. I. (Donets Physical-Technical Inst., USSR). Zh. Eksp. Teor. Fiz.; 66: No. 3, 1019-1027(Mar 1974). (In Russian).

The electron dislocation deceleration coefficient and the change in the disordering effect in superconductors containing nonmagnetic impurities are calculated in the model of two overlapping bands. It is shown that the magnitude of the change depends on the product of two functions each of which depends only on a single argument (concentration or temperature). The concentration dependence of variation of the disordering effect can be described by a nonmonotonous function of the impurity concentration. Some of the experimental data are analyzed on basis of the results obtained. (auth)

4793 SUPERCONDUCTIVITY IN POLYCRYSTALLINE BISMUTH FILMS. Petrosyan, V. I.; Molin, V. N.; Vasin, O. I.; Skripkina, P. A.; Stenin, S. I.; Batyev, E. G. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 3, 996-1004(Mar 1974). (In Russian).

Thin polycrystalline bismuth films (50 to 200 Å) possessing superconductivity with $T_c \sim 5$ to 6°K are obtained by electric explosion. The mechanism of formation and stabilization of the superconducting phase is studied. An analysis of the structure and electric properties of the films shows that superconductivity is due to the appearance during crystallization of layers of amorphic bismuth at the boundary of the grains forming a net-like superconducting structure in the plane of the film. Such structures behave as continuous superconducting films. (auth)

4794 ENERGY GAP OF THE SUPERCONDUCTING SEMICONDUCTOR $SrTiO_{3-x}$ DETERMINED BY TUNNELING. Binnig, G.; Hoenig, M. E. (Univ., Frankfurt am Main). Solid State Commun.; 14: No. 7, 597-601(1 Apr 1974).

From measurements of the differential resistance for tunneling junctions prepared from $SrTiO_{3-x}$ and In(Bi) electrodes with Schottky tunneling barriers the superconducting energy gap of $SrTiO_{3-x}$($n = 3 \times 10^{19}$ cm^{-3}) is derived. Indications are found for the fact that the 1.9 MeV soft phonon mode Γ_{25} in tetragonal $SrTiO_3$ is important for the effective electron–electron interaction in superconducting $SrTiO_{3-x}$. (auth)

4795 SUPERCONDUCTING Al MICROBRIDGES WITH REDUCED SELF-HEATING. Klapwijk, T. M.; Veenstra, T. B. (Technische Hogeschool, Delft, Netherlands). Phys. Lett.; 47A: No. 5, 351-352(22 Apr 1974).

The Josephson weak link behavior of small Al microbridges was found to be severely limited by Joule heating. Significant improvement was obtained by fabricating bridges much thinner (~0.1 μm) than the adjacent film (~1 μm). (auth)

4796 TEMPERATURE DEPENDENCE OF THE HEAT CAPACITY OF A SUPERCONDUCTING FILM IN THE VICINITY OF T_c. Solinsky, J. C.; Goldman, A. M. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1569. Phys. Lett.; 47A: No. 5, 359-360(22 Apr 1974).

Measurements of the temperature dependence of the heat capacity of granular aluminum films have been carried out using ac calorimetry. The results indicate a peak in the heat capacity at the low temperature end of the transition. (auth)

4797 LOW TEMPERATURE ENHANCEMENT IN THE SPECIFIC HEAT OF GERMANIUM TELLURIDE. Lewis, J. E. (State Univ. of New York, Plattsburgh). Phys. Lett.; 47A: No. 5, 404-406(22 Apr 1974).

The specific heat of single crystal germanium telluride has been measured in the interval 1.2 to 22°K. A specific heat enhancement has been found between 1 and 5°K, with a broad maximum at 1.83°K. (auth)

4798 THERMOELECTRIC GENERATION OF FLUX IN A BIMETALLIC SUPERCONDUCTING RING. Garland, J. C.; Van Harlingen, D. J. (Ohio State Univ., Columbus). Phys. Lett.; 47A: No. 5, 423-424(22 Apr 1974).

A model is described for the thermoelectric generation of magnetic flux in a bimetallic superconducting ring whose junctions are fixed at different temperatures. The magnitude of the flux is expected to be well within the resolution of modern magnetometry techniques. (auth)

4799 SUPPRESSION OF SUPERCONDUCTIVITY IN RUTHENIUM ALLOYS. Williams, G. (Univ of Manitoba, Winnipeg). Solid State Commun.; 14: No. 7, 649-652(1 Apr 1974).

Existing data on the depression of the superconducting transition temperature of Ru by Co, Ni, Pt, Pd, Rh, and Ir impurities are analyzed using Kaiser's model, which considers resonant scattering from nonmagnetic impurity states. Numerical values for various parameters characterizing this resonant d-state are thus derived; in particular estimates of the intra-impurity Coulomb repulsion are obtained from which the presence (or absence) of localized spin fluctuations in these alloy systems is inferred. (auth)

4800 CRYSTALLIZATION OF SUPERCONDUCTING Nb–Ga ALLOYS AT A HIGH COOLING RATE. Bychkov, Yu. F.; Kamenetskaya, D. S.; Kruglov, V. S.; Sizov, B. T. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 4, 754-759(Oct 1973). (In Russian).

The effect of a high cooling rate on the crystallization of superconducting Nb–Ga alloys containing up to 3.25 wt.% Ga was studied. There was considerable broadening of the field of existence of the beta phase, which resulted in an increased temperature of superconducting transition compared to that in equilibrium Nb–Ga systems. The results are explained by a phase diagram of the Nb–Ga system. (tr-auth)

4801 ISOTOPIC EFFECT IN THE PHONON MECHANISM OF SUPERCONDUCTIVITY. Pyatiletov, Yu. S. (Inst. of Physics of Metals, Kiev). Fiz. Metal. Metalloved.; 36: No. 4, 679-685(Oct 1973). (In Russian).

It was shown that in the phonon mechanism of superconductivity, the index of the isotopic effect, α, depending on the type of phonon density of the compound and zone structure, may vary from 0.5 to $-\infty$. The phonon spectrum displacement to the high-frequency region, the presence of a peak in the electron density of the states on the Fermi surface, and strong Coulomb interaction lead to optimum α values. The limiting value $\alpha = 0.5$ at low temperatures is conducive to low-frequency peaks in the phonon spectrum. (tr-auth)

4802 INCREASE OF THE INTERACTION BETWEEN ELECTRONS RESPONSIBLE FOR THE SUPERCONDUCTIVITY IN POLAR SEMICONDUCTORS WITH A DYNAMICAL INSTABILITY OF THE LATTICE. Kristoffel, N. Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 23: No. 1, 65-71(1974). (In Russian).

It is shown that in polar semiconductors with possible intervalley scattering at the Brillouin-zone boundaries by the soft transversal optical vibrational mode, a remarkable increase in the effective interelectronic attraction with temperature lowering towards the point of the structural transition is expected. It seems to provide additional possibilities to obtain superconductivity. The concentration of the conduction electrons must not be high in such a situation. (auth)

4803 VARIATIONAL SOLUTION OF THE SUPERCONDUCTING PROXIMITY EFFECT FOR ARBITRARY MEAN FREE PATH. Silvert, W. (Dalhousie Univ., Halifax, Nova Scotia). Solid State Commun.; 14: No. 7, 635-638(1 Apr 1974).

An improved variational calculation of superconducting transition temperatures for nonhomogeneous systems with arbitrary electron mean free path has been developed. This form of the variational theory is at least as accurate as the diffusion theory. Calculations have been carried out for both planar and spherical geometries; an approximate scaling law is obtained, involving a characteristic length which is essentially the generalized coherence length of Silvert and Cooper. (auth)

4804 POSSIBILITY OF TWO-BAND CHARACTER DEVELOPMENT IN ABSORPTION OF LONGITUDINAL SUPERSOUND IN SUPERCONDUCTING NIOBIUM OF DIFFERENT FREQUENCY. Druinskii, E. L.; Fal'ko, I. I. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 146-147(Jan 1974). (In Russian).

The dependence of the absorption coefficient of the longitudinal supersound on the reduced temperature was theoretically studied. It was shown that this dependence is a function of the parameter determined by the property of the superconductor. The possibility of a single approach to the explanation of all available experimental data on the basis of the multiband character of the Fermi surface of Nb was indicated. (tr-auth)

Equipment and Devices

4805 (FOA-2-B-2034) 1. PROMISING DESIGNS FOR STABLE PARTLY RESISTIVE QUANTUM INTERFERENCE DEVICES AND AN EASILY CONSTRUCTED SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE. Slettenmark, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1972. 7p. INIS.

Stable C-shaped and symmetric dc and rf voltage-biased superconducting quantum interference devices (SQUIDs) have been designed and tested for different applications. An easily constructed rf SQUID with the critical current of the point contact adjustable from outside the cryostat is described. General experience in constructing and operating the various devices is reported. (auth)

4806 (N-73-28715) THIN POLYMER INSULATOR FOR JOSEPHSON TUNNELING APPLICATIONS. Final Report. Wilmsen, C. M. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). Jul 1973. 38p. (NASA-CR-121270). NTIS $4.00.

The use of an organic monolayer formed from a vapor as an insulating barrier for thin film Josephson junctions is considered, and the effect of an organic monolayer on the transition temperature of a thin film superconductor is investigated. Also analyzed are the geometric factors which influence Josephson junctions and Josephson junction interferometers. (auth)

4807 PATTERN-GENERATORS AND TECHNIQUE FOR ELECTRON-BEAM FABRICATION OF SUBMICRON THIN-FILM BRIDGES FOR SUPERCONDUCTIVITY STUDIES. McCarthy, S.L.; Stanko, J. (Department of Physics, State University of New York, Stony Brook, New York 11790). Rev. Sci. Instrum. 45: No. 3, 335-340 (Mar 1974).

A low-cost technique is discussed for fabricating bridges down to 0.12μ in width in aluminum using a conventional scanning electron microscope without a beam-blanking facility. A detailed discussion is also given of the bridge pattern generators for the rectangular and Anderson-Dayem geometries. The successful use of Shipley AZ-1350 as an electron resist is reported. (auth)

4808 ENERGY STORAGE AND SWITCHING WITH SUPERCONDUCTORS. Garwin, R. L. (to United States Atomic Energy Commission). US Patent 3,800,256. 26 Mar 1974. Filed Date 24 Apr 1973. 8p.

The disclosure relates to a superconducting energy storage and switching apparatus. A superconducting energy storing device, such as a coil, is surrounded and cooled by, for example, liquid helium. A switch comprising a material having relatively high resistivity when normal and superconducting at very low temperatures is electrically connected to the superconducting energy storage device. The switch is immersed in a dewar separate from the coil so that the temperature of the switch can be controlled independently of the temperature of the coil to provide electrical switching capability without loss of energy storing efficiency. (auth)

4809 NANOSECOND PULSE TRANSMISSION THROUGH SUPERCONDUCTING COAXIAL CABLE. Bordovskii, V. S.; Gal'perovich, D. Ya. Radiotekhnika (Moscow); No. 11, 51-55 (1972). (In Russian).

A description is given, in theoretical terms, of miniature superconducting cable with an inner niobium conductor and an outer lead conductor. The cable becomes superconductive when placed in a bath of liquid helium, at a temperature of 4.2°K, which is below the critical temperature level for both niobium and lead. The use of superconductive cable is especially beneficial in the transmission of nanosecond pulses because of its tendency to reduce distortion of the pulse shape, the result of low losses in the metal and in the dielectric. Using the experimental data from an earlier article and the theoretical results of another, it is shown that the losses in the superconducting cable dielectric in the frequency range corresponding to the spectra of the nanosecond pulses are commensurate with the losses in the metal, and may even be higher. Photographs of the cable and of its transmitted pulses are shown. In the experimental part the transmission of 180 ns pulses with a leading edge of 0.2 ns through superconducting cable 135 m long and with a characteristic impedance of 75 ohms was tested. (JPRS)

4810 NEW SUPERCONDUCTING SWITCH. Harrowell, R. V. (PA Tech. and Science Centre, Cambridge, Eng.). J. Phys., D (London); 7: No. 4, 491-499(1 Mar 1974).

The sharp, reversible transition of a superconductor from the normal to the superconducting state gives it obvious switching properties. One use for such a switch would be the protection of power-system components, especially superconducting cables and generators, which are now being developed. The bulk of the paper is concerned with a preliminary design study of such a device. The required lengths of superconductor are such (~1 km) that burnout at regions of low critical current (I_c) would be probable before the rising fault current in the whole superconductor reaches the average I_c and switching occurs. The proposed switch avoids this difficulty by backing the superconductor with a semiconductor which has a negative temperature coefficient of resistance in the relevant temperature range, thus preventing the catastrophic temperature rise that would occur in the normal superconductor alone because of its positive temperature coefficient. The crucial requirement of the semiconductor is that it should have, just below its melting point, the correct intrinsic resistivity, for which an expression is derived. An illustrative design for a high-power generator-protection switch is worked out, and problems and incentives are outlined. (auth)

4811 I-V CHARACTERISTICS AND STATIONARY DYNAMICS OF A JOSEPHSON JUNCTION INCLUDING THE INTERFERENCE TERM IN THE CURRENT PHASE RELATION. Schlup, W. A. (IBM Research Lab., Zurich). J. Phys., C (London); 7: No. 4, 736-748(21 Feb 1974).

The equation of motion for a local Josephson junction will be solved assuming a current phase relation $j_s = \sigma_0 V + \sigma_1 V \cos \phi + j_1 \sin \phi$, whose parameters σ_0, σ_1, j_1 are calculated as appropriate averages from BCS weak-coupling theory. Analytical solutions can be given in the case of strong and weak damped junctions, the latter even for small currents. The I-V characteristics and the stationary dynamics will be discussed for various damping parameters and relative conductivities. The critical current as a function of these quantities is also investigated. (auth)

4812 EXPERIMENTAL STABILIZED SUPERCONDUCTING MAGNET WITH AN INSIDE DIAMETER OF 700 mm. Vetlitskii, I. A.; Belonogov, A. V.; Dobrov, V. M.; Krylov, V. L.; Lebedev, A. V. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 5, 1555-1558 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 5, 217-221(1973).

A stabilized superconducting magnet with an inside diameter of the winding equal to 730 mm and an outside diameter of 1000 mm, a maximum magnetic field induction of 2.4 T, a working current of 820 A, a design current density of 2560 A/cm², a stored energy of 500 kJ, a superconductor (Nb + 50% Zr alloy) weight of 23 kg is described. A description is given of the construction of the magnet, and results are presented of tests performed on the magnet in order to study the conditions governing stabilization and the development of induced currents in the winding. (auth)

4813 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTORS. McDougall, I. L.; Barber, A. C. (to Imperial Metal Industries (Kynoch) Ltd.). British Patent 1,341,726. 28 Dec 1973. Filed date 4 Feb 1971. 8p.

A method is described for manufacturing a superconductor that incorporates a superconductive intermetallic compound of at least two elements. The method includes the steps of producing a filament or filaments of at least one of the elements, embedded in and supported by a matrix material. At least part of the matrix material is then converted to a substance that includes the remainder of the elements, and the material is then heated to produce the required compound. The elements may be added to the matrix material and diffused therethrough, or may be vapor deposited on to the matrix material. The matrix material may comprise Cu, Ag, or Ni, and the filament(s) may comprise Nb. Sn may be vapor deposited on the matrix material. (UK)

4814 UTILIZATION OF INTERFERING CURRENTS IN SUPERCONDUCTORS FOR PRODUCING HIGHLY-SENSITIVE ELECTRICAL MEASURING INSTRUMENTS. Gubin, L. P. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 10, 1497-1500(Oct 1973).

Translated from Izmer. Tekh.; 16: No. 10, 39-41(Oct 1973).

The utilization of the current-interference phenomenon in superconductors for producing electrical measuring instruments serves greatly to expand the boundary of electromagnetic measurements towards very small values. Moreover, it was found that the voltage, current, and magnetic flux are related to the fundamental physical constant, the magnetic flux quantum h/2e. This fact makes it possible to expect a transfer in the field of electromagnetic measurements to a natural electromagnetic reference standard. (auth)

PHYSICS (NUCLEAR)

4815 TRENDS IN NUCLEAR PHYSICS: THE CHALLENGE OF PRECISION. Bromley, D. A. (Yale Univ., New Haven). pp 21-92 of Proceedings of the International Conference on Nuclear Physics. Vol. 2 de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

An overview on new developments in conventional nuclear physics and heavy-ion physics is presented. Three significant trends are noted: toward high precision throughout nuclear physics, toward use of higher energy and mesonic probes, and toward use of heavy projectiles. New knowledge has been gained about nuclear matter, nuclear structure (very heavy nuclei, bubble and toroidal nuclei), and fundamental laws and symmetries of nature. The scope of this comprehensive paper can be given by citing the section headings, as follows: The nuclear domain; Nuclear morphology (size, giant multipoles, shapes, bubble nuclei); Fission; Transuranic species; Supertransuranic species; Transfer spectroscopy in light nuclei (quartet structure in nuclei); Higher-order effects in transfer reactions (deuteron breakup, coupled-channel phenomena, recoil, forward peaking, complementarity of light- and heavy-projectile reactions); Heavy-ion scattering; Coherent transfer reactions; Structure in the nuclear continuum (nuclear expansion, sharp states in the continuum, the decay of highly excited $T_>$ levels, separation of ordinary compound-nucleus phenomena from other processes); High-spin states in nuclei; Polarization phenomena (polarized deuterons in stripping reactions, absolute polarization of neutrons in n–^{12}O scattering, radiative capture of polarized protons, polarized fission studies); Nuclear lifetime measurements; Fundamental aspects of nuclear physics (the nucleon–nucleon interaction, parity nonconservation in nuclei, nuclear beta decay, quantum electrodynamics); and Conclusions. (57 figures, 3 tables, 256 references) (RWR)

Neutron Interactions with Matter

Refer also to abstracts 3928, 5040, 5210, 5211, 5356, 5551, 5552, 5563–5565, and 5570.

4816 (CONF-740320-1) MODELS, MEASUREMENTS AND EVALUATION. Guenther, P.; Moldauer, P.; Smith, A. (Argonne National Lab., Ill. (USA)). 1974. 39p. Dep. NTIS $5.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

A unified program of physical measurements and theoretical calculations for the provision of evaluated neutron data in the continuum region is outlined. The basic theoretical concepts are the optical coupled-channel, and statistical R-matrix models. The complementary measurement program provides the essential experimental foundation consisting primarily of neutron total and scattering cross sections. The integrated use of experiment and theory to provide evaluated data sets is discussed including average total and elastic scattering cross sections and the optical and coupled-channel models, inelastic neutron scattering cross sections and the statistical and direct-reaction models, and resonance statistics and fluctuations. The importance of physical concepts is emphasized throughout. (17 figures) (auth)

4817 (EURFNR-1138) ATTOW-K: THE KARLSRUHE IBM360/65 VERSION OF THE 2d REMOVAL DIFFUSION SHIELDING CODE ATTOW. Boenisch, G.; Wiese, H. W. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Oct 1973. 129p. Dep. NTIS $9.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The IBM7090-version of the removal-diffusion shielding code ATTØW for two dimensional geometry (x,y or r,z) was converted for the Karlsruhe IBM360/65-370/165 computer. The new version can utilize Karlsruhe multigroup constant sets either already in core storage or from external storage. Furthermore the SABINE removal cross section library was built in. The input description has been partly reformulated and augmented by additional explanations. (auth)

4818 (INIS-mf-825) ACCELERATION OF NEUTRON DIFFUSION CALCULATION BY A COARSE MESH REBALANCING METHOD USING ADDITIVE BILINEAR CORRECTIONS. Melice, M.; Hunin, C. (Compagnie Generale d'Entreprises Electriques et Industrielles, S. A. (ELECTROBEL), Brussels (Belgium)). 1973. 31p. INIS.

In diffusion codes based on finite difference schemes, a correct description of the core requires 1 or 2 mesh intervals per diffusion length. In the case of a large PWR reactor, this leads to more than 20,000 mesh points for 2-D, and several millions for 3-D, calculations. An effort for developing faster codes is thus justified. We adopted coarse mesh rebalancing methods to achieve very fast convergence. (INIS)

4819 (INIS-mf-827) DETERMINATION OF THE FACTORIZED FUNCTIONS OF THE SLOWING DOWN MODEL GENERALIZED TO THE Nth ORDER. Rocca-Volmerange, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). 1973. 3p. INIS.

Our purpose is to solve the simplified Boltzmann equation in a zero-dimensional case and an homogeneous infinite medium $\Sigma_t(u)\,\Phi(u) = \rho(u) + S(u)$; $\rho(u) = \psi(u,o) = \int_{-\infty}^{u} \Sigma s(u')\,\Phi(u')P(u' \rightarrow u)du'$ and to determine the fast neutron spectra. (INIS)

4820 (ITEF-948) DESCRIPTION OF ALGORITHM AND SOLUTION PROGRAM FOR MULTIGROUP, MULTIZONE, ONE-DIMENSIONAL PROBLEM OF NEUTRON PROPAGATION. Rumyantsev, I. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 14p. (In Russian). INIS.

There are presented an algorithm and short account of a program for the solution of a system of Fredholm integral equations of the second type, obtained in the investigation of the multigroup, multizone, one-dimensional problem of the penetration of neutrons through matter. A new iteration scheme is proposed. The results are compared with experimental data. (1 figure) (tr-auth)

4821 (JAERI-1228) PROCEEDINGS OF THE 3RD SEMINAR ON NEUTRON CROSS SECTIONS. Nishimura, K. (Ed.). (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 197p. NTIS (US Sales Only).

Separate abstracts were prepared for the 20 reports in this volume. (RWR)

For abstracts of individual papers see: 4074, 4110, 4822–4824, 4840, 4926, 4997, 4998, 5039, 5040, 5091, 5106–5111, 5470, and 5555.

4822 (JAERI-1228, pp 79-87) MEASUREMENT AND ANALYSIS OF ENERGY AND SPACE DISTRIBUTION OF NEUTRONS IN A THORIA ASSEMBLY. Nishihara, H. (Kyoto Univ.); Kanazawa, S.; Miki, K.; Kimura, I.; Kobayashi, K. Jul 1973. (In Japanese).

Energy spectra of fast and intermediate neutrons and the spatial distribution of fast neutrons in a thoria assembly were measured by the time-of-flight method and by activation of nickel wires, respectively. The results are in good agreement with the spectra and distribution which are predicted by the DTF-IV code with the input of JAERI-FAST 70-group cross section set (JAERI-M 4927 for ^{232}Th). The immediate object is to assess the 70-group cross sections for ^{232}Th. The same methods of experiment and analysis were applied to an iron and an alumina assembly, for the purpose of testing their applicability. It has been found that the JAERI-FAST cross sections for iron yield insufficient slowing-down of neutrons to energies below the large resonance scattering at 28.5 keV. (auth)

4823 (JAERI-1228, pp 88-90) ELASTIC SCATTERING REMOVAL CROSS SECTION OF IRON. Yamamuro, N. (Tokyo Inst. of Tech.). Jul 1973. (In Japanese).

In order to obtain the group elastic removal cross section in an undiluted material, hitherto, the self-shielding factor for the elastic scattering cross section was used. However, for the group in which there is a strong resonance scattering, the self-shielding factor for the elastic removal cross section should be prepared because the weighting flux of group boundary is quite different from the average flux in that group. In this article the self-shielding factor for the elastic removal cross section of iron in the range of 4.65 keV to 800 keV have been calculated. We found the discrepancy up to a factor about 10 between the elastic removal cross sections of the present calculation and values resulting from the JAERI-FAST set. (auth)

4824 (JAERI-1228, pp 97-101) ADJUSTMENT OF CROSS SECTION DATA BY USING INTEGRAL DATA. Kurol, H. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. (In Japanese).

The LSQ method used for adjusting the cross section data library AGLI on which cross section data are given in the 1950 equilethargy group structure is described. The integral data used for the present adjustment are about 60 criticalities and reaction rate

ratios measured in an appropriate series of critical experiments. The graphic display and light-pen system ARCADIA, which is a powerful tool to adjust the AGLI library by utilizing information obtained by the LSQ method, is introduced. The adjusted results and practical experience obtained in the present adjustment are discussed. (auth)

4825 (JAERI-M-5351) MEASUREMENT OF ANISOTROPIC NEUTRON DIFFUSION COEFFICIENTS IN THE H_2O–Al SQUARE LATTICES BY PULSED NEUTRON METHOD. Kaneko, Y.; Akino, F.; Suzuoki, Y.; Kitadate, K.; Kurokawa, R. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 34p. (In Japanese). NTIS (US Sales Only).

Neutron diffusion coefficients were measured for the light water square lattices (pitch 19 and 24 mm) with aluminum channels (dia. 15 mm) in both the axial (D_{axial}) and the radial (D_{radial}) directions, by means of the pulsed neutron technique. The measured results were compared with those of calculation based on either the 2-dimensional discrete S_n or the Benoist method, taking into consideration of the anisotropic scattering by use of transport-corrected scattering cross sections. Fairly good agreement was obtained between theory and experiment for D_{axial} as well as D_{radial}. The relation between extrapolation distance and effective transport length in the axial direction, I_{axial} and D_{axial}/V was also studied. The ratios of I_{axial} to $3\ D_{axial}/V$ were then numerically determined from the plots of calculated neutron fluxes, which are slightly higher than the widely used value of 0.71. This latter value has never been postulated in interpretation of the geometrical buckling of heterogeneous media. (auth)

4826 (JAERI-M-5395) BIBLIOGRAPHY FOR THERMAL NEUTRON SCATTERING (FOURTH EDITION, 1973). (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 208p. NTIS (US Sales Only).

The thermalization Group of the Japanese Nuclear Data Committee has continued the compilation and publication of the bibliography for thermal neutron scattering. The last one is the third edition of the bibliography, (JAERI 4043, Third Edition) issued in 1971. The present one is the fourth edition, which contains nearly nineteen hundreds articles, including the articles compiled in the old editions and all additions collected by the group members up to May 1973. They are needed for data evaluation, which is one of the main activities of the committee. (auth)

4827 (JAERI-M-5399) MEASUREMENT OF DIFFERENTIAL THERMAL NEUTRON SPECTRA IN GRAPHITE POISONED WITH INDIUM, CADMIUM, AND SAMARIUM BY TIME-OF-FLIGHT METHOD. Akino, F.; Kaneko, Y.; Hanna, S. F.; Kurokawa, R.; Kitadate, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 39p. NTIS (US Sales Only).

Differential neutron spectra were measured in parallelepiped graphite assemblies ($80 \times 80 \times 40$ cm^3) with densities of 0.74–0.72 consisting of a homogeneous mixture of the powders of graphite and neutron absorber such as indium oxide, cadmium sulfate and samarium oxide by the time-of-flight method using a JAERI 120-MeV electron linear accelerator. The results were compared with those calculated by 50-energy group, one-dimensional S_4 approximation with ENDF/A neutron scattering kernel, Young and Koppel's model. In normalization between theory and experiment at 2 eV, the calculated spectra are lower than the measured ones at 0.1 eV by about 30–50%, far beyond the discrepancies expected from defects of the scattering kernel used in the calculation. The cause for this is possibly inaccurate treatment of the neutron leakage in the slowing-down energy region. To obtain experimental data for the high-temperature graphite piles, the piles should thus be dense and large enough to describe the neutron leakage during slowing-down to the thermal energy region by the discrete S_n method. (auth)

4828 (JINR-E14-7648) STUDY OF UNIAXIAL MOLECULAR REORIENTATIONS BY COLD NEUTRON SCATTERING. Goyal, P. S.; Natkaniec, I.; Nawrocik, W.; Domoslawski, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

The expression for the cross section of neutron quasielastic scattering from a molecule reorienting about a fixed axis was derived. Three possibilities for the angular jump lengths are discussed and it is shown that neutron quasielastic scattering technique can be used for investigating the rate and geometry of reorientations in molecular crystals. (auth)

4829 (NIIAR-P-197) AUTOMATION OF THE CHOICE OF METHOD AND THE COORDINATE GRID FOR THE NUMERICAL SOLUTION OF MULTIGROUP NEUTRON TRANSPORT EQUATIONS. Zizin, M. N.; Yaroslavtseva, L. N. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 29p. (In Russian). INIS.

Algorithms for the automation of the choice of coordinate grid in the S_n method and some results of calculation are discussed. A program is described which permits the use of different numbers of calculated nodes in different groups. The results of calculations by this program with automatic choice of coordinate grid are set forth. A phenomenological approach to the choice of method and order of approximation in the solution of the multigroup equation for neutron transport is suggested. A comparison of presented algorithms is carried out, and some recommendations for their use are given. (8 tables) (tr-auth)

4830 (ORNL-4892) FINAL REPORT ON A BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT THROUGH IRON AND STAINLESS STEEL. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 111p. Dep. NTIS $5.45.

An experiment concerning neutron penetration in iron and stainless steel is described, and experimental results are presented which provide a basis for verification of the accuracy of iron cross sections to be used in transport calculations. The experiment was performed at the Tower Shielding Facility of ORNL and included measurements of both the neutron fluence and neutron spectra through samples of iron up to 3 ft thick and of stainless steel up to 18 in. thick. Calculations of the experiment were performed with a special version of the MORSE multigroup Monte Carlo code which uses point total cross sections. Comparison of the calculations with experiment indicates that the recently evaluated MAT 4180-Mod. 1 iron cross-section set is superior to the older MAT 1101 and MAT 1124 sets. Calculations using this newest set result in total neutron leakages above thermal energies penetrating up to 3 ft of iron or 18 in. of stainless steel that agree with experiment to within about 20%. The calculated leakage spectra above 90 keV arising from scattering through up to 1 ft of iron or 18 in. of stainless steel also agree with experiment to within about 20%. Using any of the three sets, the calculated unscattered component through 1 ft of iron or stainless steel above 1 MeV is only accurate to within about 40%. (auth)

4831 (TKK-F-A-193) VARIANCE REDUCTION IN MONTE CARLO CALCULATIONS OF MULTIPLE SCATTERING IN NEUTRON EXPERIMENTS. Kalli, H. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). 1972. 43p. INIS.

Techniques for increasing the computational efficiency in the Monte Carlo estimation of multiple scattering in neutron scattering experiments are discussed. The results are obtained by studying means of reducing the variance for the twice-scattered neutrons. In thin slab samples the variance is shown to be strongly dependent on the probability density function used in sampling the neutron direction after the first scattering. Studies of simple one-velocity cases indicate the proper choice of this probability density function. Multiple scattering in a free gas sample is studied as an application. (auth)

4832 BENCHMARK VALUES FOR THE SLAB AND SPHERE CRITICALITY PROBLEM IN ONE-GROUP NEUTRON TRANSPORT THEORY. Kaper, H. G.; Lindeman, A. J.; Leaf, G. K. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 1, 94-99(May 1974).

Benchmark data are presented for the one-group criticality problem for the uniform slab and the uniform sphere in vacuum. The data which were obtained on the basis of the results of analytical transport theory refer to the critical parameters of the system as well as the particle density inside the system. (auth)

4833 EFFECTS OF HIGHLY ANISOTROPIC SCATTERING ON MONOENERGETIC NEUTRON TRANSPORT AT DEEP PENETRATIONS. Oblow, E. (Oak Ridge National Lab., TN); Kin, K.; Goldstein, H.; Wagschal, J. J. Nucl. Sci. Eng.; 54: No. 1, 72-84(May 1974).

The sensitivity of the flux in deep-penetration problems to anisotropic scattering was studied within the framework of monoenergetic transport theory. Several parameterized, anisotropic scattering kernels were used to represent a general class of anisotropies. The representation of these kernels in Legendre polynomial series of various orders was explored to determine their effect on calculated discrete eigenspectra and infinite medium fluxes. Eigenspectra for several kernels are presented as a function of the kernel parameter. Conclusions were drawn about the order of the Legendre expansion of the kernels required for accurate deep-penetration calculations and the possible existence of multiple diffusion decay modes in realistic problems. In general Legendre expansions of rather low order were found to be adequate for problems in which the scalar flux was the primary quantity of interest. (9 figures, 5 tables) (auth)

4834 AGE OF CALIFORNIUM-252 FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN WATER. Spiegel, V. (National Bureau of Standards, Washington, DC). Nucl. Sci. Eng.; 54: No. 1, 28-34(May 1974).

The age of ^{252}Cf fission neutrons to indium resonance energy (1.44 eV) was measured in water by using a source encapsulated in a 7.6-mm-diam by 7.6-mm-high cylinder. The correction for the displacement of the moderator by the source was experimentally determined to be −0.13 cm^2 or about −0.5% in approximate agreement with calculation. The distribution of indium resonance energy neutrons close to the source was measured to be Gaussian. The age measured for this experiment was 28.69 ± 0.39 cm^2. An average energy for the ^{252}Cf neutron spectrum of 2.21 ± 0.05 MeV is inferred from this age. (5 figures, 2 tables) (auth)

4835 THREE GROUP INVESTIGATION OF SPACE AND ENERGY DISTRIBUTIONS OF REACTOR NEUTRONS AT THEIR PENETRATION THROUGH IRON AND LEAD NEUTRON GUIDES. Troshev, T.; Khristov, V.; Apostolov, T. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 24: 181-190(1973). (In Bulgarian).

Investigations on the space and energy distributions of reactor neutrons passing through homogeneous and non-homogeneous neutron guides placed in aquatic media are reported. Neutron guides from iron and lead were tested as well as neutron guides with periodic non-homogeneity from paraffin or air. Threshold miniature crown counters with a coating of B and ^{238}U were used in the experiments. Experimental data were obtained for the effective diffusion length in neutron guides and are compared with the data obtained from calculations by means of a twenty-six group computer program. The space distribution of thermal and above thermal neutrons in the iron-paraffin neutron guide shows vividly expressed maximums, stronger for thermal neutrons, which may be explained with the increased delay coefficient of the resonance neutrons in the iron. These effects are not observed in the lead neutron guides. (auth)

4836 RESONANCE GROUP CROSS-SECTIONS FOR MULTIGROUP CODES. Huria, H. C.; Rastogi, B. P.; Paranjape, S. D. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

In the generation of group constants for multigroup codes, the resonance energy range requires special treatment because of pronounced fine structure in cross-sections of main fertile and fissile nuclides in particular. This aspect and the variation of cross-sections with temperature of the medium make the effective cross-sections composition and temperature dependent. An attempt has been made to present the methods used in the generation of resonance group cross-sections for the multigroup codes being developed here. Some results for ^{238}U, ^{235}U, ^{239}Pu and ^{232}Th are also discussed. (auth)

4837 USE OF JACOBI-POLYNOMIALS IN TRANSPORT THEORY OF MONOENERGETIC NEUTRONS. de Corte, L. Ghent; Ghent State Univ. (1973). 257p. (In Dutch). Centre d'Etude de l'Energie Nucleaire, Mol, Belgium.

Thesis.

All methods leading to the expansion in series of the angular distribution function originate from the Boltzmann equation. Neutrons having a constant velocity and isotropic diffusion are considered. The Nonnenmacher theory is extended using Jacobi polynomials instead of Legendre polynomials, and the problem of reflection and transmission of neutrons is studied in the case of a plane infinite surface. (JFP)

4838 MODERATION OF RESONANCE NEUTRONS IN MATTER. V. Kozhevnikov, D. A.; Khavkin, V. S.; Belizhanin, V. A. Sov. J. At. Energy (Engl. Transl.); 34: No. 4, 350-351(Apr 1973).

Translated from At. Energ. (USSR); 34: No. 4, 283-284(Apr 1973).

The spatial dependence of the neutron moderation time and the three-dimensional distribution of moderated neutrons at large distances from the source in anisotropic scattering are considered. (MHR)

4839 PSEUDO-MODE ANALYSIS OF NEUTRON WAVE PROPAGATION IN POLYCRYSTALLINE MODERATORS. Yamagishi, T. (Osaka Univ., Suita, Japan). J. Phys., D (London); 7: No. 4, 510-525(1 Mar 1974).

Neutron wave propagation in a polycrystalline prism is analyzed via a velocity-dependent transport equation with a simple scattering kernel. Particular attention is devoted to examining the behavior of sub-Bragg neutrons, and the effects of temperature and transverse buckling on the neutron waves. The contribution from the sub-Bragg continuum (pseudo-mode) is made possible to compute by the use of the analytical continuation of the dispersion function in the case of $1/v$-form cross sections. Numerical results of the energy spectrum and detector response of neutron waves are presented for beryllium and graphite. The interference phenomenon between the discrete modes and pseudo-modes is also demonstrated for various temperatures and transverse bucklings. (auth)

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Refer also to abstracts 3423, 4291, 4560, 4563, 4682, 4703, 4966, 4996, 5016, 5049, 5138, and 5153.

4840 (JAERI-1228, pp 139-149) ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS OF 14.1 MeV NEUTRONS BY HYDROGEN ISOTOPES. Shirato, S. (Rikkyo Univ., Tokyo). Jul 1973. (In Japanese).

We have measured the differential and total cross sections for the reactions ^{1}H(n,n)p, ^{2}H(n,n)d, ^{2}H(n,p)2n, ^{2}H(n,n)t, ^{3}H(n,d)2n, and ^{3}H(n,p)3n at 14.1 MeV, by using a counter telescope. Our published and newly corrected data are summarized and compared with the data of other authors as well as theoretical results. We also present the details of experimental procedures and data reduction. (auth)

4841 ABSOLUTE CROSS SECTIONS IN ^{2}H- AND ^{3}He-INDUCED BREAKUP REACTIONS. Lim, T.K. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). Phys. Rev. Lett. 31: No. 20, 1258-1260 (12 Nov 1973).

The absolute magnitudes and shapes of the cross sections of a number of ^{2}H- and ^{3}He- induced quasifree scattering processes are correctly predicted by the use of Eckart cluster-model wave functions for the light nuclei involved and a simple, but physically plausible, modification of the Rogers-Saylor attenuation model. (auth)

4842 CALCULATION OF THE CROSS SECTION OF THE REACTION d(d,dp)n IN THE REGION OF COMPARATIVELY SMALL NEUTRON AND PROTON ENERGIES. Dubovoi, E. L.; Yakovenko, V. P. (Radiotechnical Inst., Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2644-2648(Dec 1973). (In Russian).

The amplitude of the reaction d(d,dp)n, satisfying the triangular nonrelativistic Feynman diagram is calculated. The collision of deuterons with virtual nucleons and the subsequent rescattering of virtual neutrons and protons are described. The isospin and spin of the particles is considered in the calculation. (tr-auth)

4843 RADIATIVE CAPTURE OF PROTONS BY DEUTERONS AT E_p = 16 MeV. Matthews, J. L. (Rutgers—The State Univ., New Brunswick, NJ); Kruse, T.; Williams, M. E.; Owens, R. O.; Savin, W. Nucl. Phys.; A223: No. 2, 221-233(1974).

The differential cross section for the ^{2}H(p,^{3}He)γ reaction was measured at proton energy E_p = 16 MeV. (This energy corresponds to photon energy E_γ = 16.1 MeV in the inverse ^{3}He(γ,d)^{1}H reaction.) The ^{3}He particles were detected by a position-sensitive counter telescope in the focal plane of a magnetic spectrograph. The angular distribution of the reaction was deduced from the measured ^{3}He energy spectrum. The absolute cross section was determined by normalization to concurrent measurements of the ^{2}H(p,p)^{2}H reaction whose cross section is accurately known. The radiative capture results are compared with other data on this process and its inverse. The present measurements aid in resolving sizable discrepancies between several sets of previous data and thus allow a meaningful comparison with recent theoretical calculations. (auth)

4844 RECOIL CORRECTIONS FOR SINGLE-NUCLEON TRANSFER REACTIONS. Hauge, P. S. (Michigan State Univ., East Lansing). Nucl. Phys.; A223: No. 2, 394-408(1974).

A formalism is developed for approximately treating the recoil of the projectile in single-nucleon transfer reactions. The "no-recoil" term is evaluated exactly by rotating the nuclear matrix element to a coordinate system where the lighter projectile lies along the z-axis relative to the target nucleus. Recoil terms are constructed by expanding the "recoil phase factor" in terms of spherical harmonic and Bessel functions, and they are again evaluated exactly. Numerical results are then obtained for some representative light-ion reactions of high incident energies. For these reactions, it is found that although the first-order recoil term may be very large, higher order terms are correspondingly less important, and convergence is always easily obtained. However, absolute magnitudes of cross sections at forward angles pre-

dicted by the present theory and by the local energy approximation differ by up to 50% for the reactions considered. (auth)

4845 ELASTIC NEUTRON–DEUTERON SCATTERING WITH LOCAL POTENTIALS. Kloet, W.M.; Tjon, J.A. (Institute for Theoretical Physics, University of Utrecht, Utrecht, the Netherlands). Ann. Phys. (N.Y.) 79: No. 2, 407-440 (Aug 1973).

Neutron–deuteron scattering is studied within the Faddeev formalism using local two–body S–wave potentials. The equations are solved by applying Padé technique to the multiple scattering series. The rate of convergence is found to be rapid enough for practical purposes. With this method the differential and total cross sections are calculated up to 50 MeV neutron laboratory energy and the results are compared with those of the separable potential model. In particular large differences are found in the forward direction of the differential cross–sections. Up to 22 MeV there is good agreement with experimental data. The differential cross–sections for local potentials up to about 14 MeV depend very little on the existence of a soft core in the two–body spin–triplet potential, but its effect becomes more important at higher energies. (auth)

4846 ANALYSIS OF INTERMEDIATE ENERGY NUCLEON–DEUTERON ELASTIC SCATTERING. Remler, E.A.; Miller, R.A. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Ann. Phys. (N.Y.) 82: No. 1, 189-247 (Jan 1974).

We present a theoretical analysis of a broad range of aspects of intermediate energy nucleon–deuteron scattering. This analysis is based on a multiple scattering approach using knowledge of the deuteron's structure and nucleon–nucleon interactions. Conversely, comparison of this theory with experiment can yield information about low and intermediate energy strong interactions. The relationship of this multiple scattering type of approach to the complementary Faddeev equation approach is discussed. Our program consists of calculating the single scattering and one nucleon exchange contributions in a realistic way then parametrizing the remaining contributions as an S–wave. We argue that the largest error in this analysis is the P–wave part of the double scattering and we give estimates of its size. The single scattering integral is evaluated numerically. Coulomb effects are neglected. We derive the relativistic expressions for single scattering and nucleon exchange and discuss the approximations made, including the off–mass–shell extrapolation of the nucleon–nucleon scattering amplitude. Fits are made to experimental measurements of differential cross sections, nucleon polarizations, and total elastic cross sections. Unitarity is maintained. We tabulate the partial waves for $J \leq 5/2$, $L \leq 2$. They are consistent with recent Faddeev calculations. We argue that with the additional calculation of double scattering the deuteron D–state percentage can be determined to the same relative uncertainty as the differential cross section. Even without the calculation of double scattering, our results indicate a D–state percentage around 8%. In an effort to provide benchmarks for future work, we have tried to be conscientious in describing our techniques and in tabulating numerical results. Comparisons are also made with earlier analyses. (auth)

4847 ODD–EVEN FEATURES IN THE EFFECTIVE INTERACTION BETWEEN LIGHT NUCLEI. Brown, R. E.; Tang, Y. C.; Thompson, D. R. pp 703-706 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The resonating-group (r-g) method in the one-channel approximation was successfully employed to describe elastic scattering in light nuclear systems. Since the imaginary potential used is expected to be nonlocal, a simple nonlocality through the inclusion in the imaginary potential of a space–exchange (Majorana) component with relative strength C_1 is employed in the calculations. It is stressed that a proper description of exchange processes in light systems is extremely important, and their inclusion in r-g calculations is one of the prime reasons that good agreement with experiment is obtained. To illustrate the quality of result obtainable, comparisons to ^{3}He + ^{4}He elastic-scattering data are shown. It is suggested that the use of Majorana components in effective interactions between heavier nuclei might be a useful way to take account of exchange effects. (auth)

4848 QUASIFREE PROCESSES IN THE REACTIONS ^{3}H + ^{3}He, ^{3}He + ^{2}H, AND ^{3}H + ^{3}H. Bondelid, R. O.; Allas, R. G.; Beach, L. A.; Lambert, J. M.; Petersen, E. L.; Slaus, I.; Shannon, D. L. pp 699-702 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Experimental data on multiparticle reactions indicate that the enhancements associated with the quasifree kinematic conditions is one of the important features, even at very low energies, $E_{inc} \sim$ 10 MeV, and even for rather complex particles. All the pertinent data are summarized on ^{3}H + ^{3}He, E_{inc} = 50 MeV ^{3}He + ^{3}H, E_{inc} = 27 MeV and ^{3}H + ^{3}H, E_{inc} = 35 MeV, and it is shown that QF reactions play an important role. When all the data are analyzed using the PWIA and the momentum wave functions $|\Psi(Q_s)|^2$ of the nucleon–deuteron or nucleon–dinucleon pair clusters are extracted, one can see good consistency between the data, a pronounced peak at $Q_s = 0$, and the ratio of various quasifree reactions involving the same transferred particle and the same virtual decomposition vertex are equal to the ratio of corresponding free cross sections indicating that the effects of FSI are rather small. (auth)

4849 DEUTERON DILATION EFFECT IN n–d BREAK-UP. Cahill, R. T. (Univ. of South Australia, Bedford Park). Phys. Lett.; 49B: No. 2, 150-152(1 Apr 1974).

From the Faddeev equations it is shown that the quasi-free scattering peak shape, in n-d break-up, is determined by an effective deuteron wavefunction. This differs from the normal deuteron wave function Ψ (r) by a distortion factor, that produces a smooth cutoff for small r. This justifies the phenomenological cutoff procedure. The same effective wave function will occur in final-state interaction theory. (auth)

4850 FORM FACTOR DEPENDENCE OF PROTON INDUCED DEUTERON BREAKUP AT LOW ENERGY. Ebenhoeh, W.; Sundqvist, B.; Johansson, A.; Amten, L.; Glantz, L.; Goenczi, L.; Koersner, I. (Tandem Accelerator Lab., Uppsala). Phys. Lett.; 49B: No. 2, 137-139(1 Apr 1974).

Proton induced deuteron breakup was studied experimentally and theoretically. The precision of the data makes it possible to distinguish between calculations made with different calculations made with different separable two-body forces. The possibility to observe off-shell effects and three-body forces is discussed. (auth)

4851 QUASI-FREE PROTON–PROTON SCATTERING IN He. Lim, T. K. pp 729-730 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The results are presented of a study on the importance of short-range correlations and the admixture of states of mixed symmetry in the few-nucleon systems, as shown by an impulse approximation analysis of the two reactions p + ^{3}He = d + p + p and p + ^{4}He = t + p + p. (auth)

4852 STUDY OF THE ^{3}He(p,2p)d AND ^{3}He(p,2p)pn REACTIONS AT 45.0 MeV. Jain, M.; Bunker, S. N.; Miller, C. A.; Nelson, J. M.; van Oers, W. T. H. pp 655-658 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The p + ^{3}He reaction was investigated over a wide range of angles in a kinematically complete experiment at 45.0 ± 0.2 MeV. The two dimensional energy spectra show prominent kinematic bands due to the ^{3}He(p,2p)d, ^{3}He(p,pd)p and ^{3}He(p,2p)d* reactions. Analysis of data was performed using the PWIA. Extracted $|\phi(\vec{q})|^2$ ($\phi(\vec{q})$ is the relative momentum wave function) for p + d and p + d* (for both the final and initial state) are shown from symmetric coplanar angles. (BRH)

4853 ^{3}He(t,d)^{4}He REACTION AT LOW ENERGIES: STRONGLY ENERGY DEPENDENT DEVIATIONS FROM THE BARSHAY–TEMMER SYMMETRY. Wagner, G. J.; Mairle, G.; Kleinagel, P.; Bilwes, R. pp 747-750 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The ^{3}He(t,d)^{4}He reaction was investigated at six energies between 1.5 and 3.3 MeV. The ratio of forward to backward differential cross sections was plotted. The ratio of 1.65 measured at 10° is by far the largest deviation from the Barshay-Temmer symmetry observed in any reaction. The source of this isospin violation is considered. (auth)

4854 SCATTERING OF DEUTERONS BY ^{3}He. Tanifuji, M.; Yazaki, K. pp 739-742 of Few Particle Problems in the Nuclear

Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Recently, a deuteron plus ^{3}He (or triton) system was studied in detail for both elastic scattering and deuteron stripping reactions, particular attention being paid to polarization phenomena. So far spin-dependent forces acting in this system were discussed by utilizing the polarization data for the stripping reaction but not yet for the scattering. The spin dependent interactions between the deuteron and ^{3}He are investigated assuming effective potentials for the elastic scattering. The qualitative feature of the spin-dependent interactions in the d + ^{3}He system is clarified by the present analysis although the potential parameters were not fully examined. (auth)

4855 INVESTIGATION OF EXCITED STATES OF ^{4}He VIA THE D(d,d)D AND THE D(d,p)T REACTIONS USING A POLARIZED DEUTERON BEAM. Grueebler, W.; Koenig, V.; Schmelzbach, P. A.; Risler, R.; White, R. E.; Marmier, P. pp 636-639 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Systematic measurements of the vector and the tensor analyzing powers of the elastic scattering of deuterons on deuterons and of the D(d,p)T reaction are reported. The vector analyzing power iT_{11} and the three tensor analyzing powers T_{20}, T_{21}, and T_{22} of the D(d,d) scattering were measured at 6.0, 8.0, 10.0, and 11.5 MeV between 20 and 62.5° lab angles. The measurements of the cross section and the analyzing powers iT_{11}, T_{20}, T_{21} and T_{22} of the D(d,p)T reaction were carried out at 9 energies between 3.0 and 11.5 MeV incident deuteron energy and lab angles between 7.5 and 160°. Preliminary results show that no simple isolated states due to a single matrix element exist between 24 and 30 MeV excitation energy in ^{4}He. (auth)

4856 SCATTERING STATES OF THE ^{4}He SYSTEM. Hackenbroich, H. H.; Heiss, P.; Stoewe, H. pp 640-643 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The γ-break-up of the α particle into p + ^{3}H and n + ^{3}He is calculated. This process is dominated by electric dipole radiation which leads to a 1^- scattering state. In the calculation α particle and 1^- scattering state wave functions were used including d-d structure, and the interaction with the electromagnetic field was treated by first order perturbation theory. The results show that the break-up process mainly leads to asymptotic states with channel spin S = 0 and orbital angular momentum L = 1. The results are compared to experimental ^{4}He(γ,p)^{3}H cross sections, satisfactory agreement being obtained. (NL)

4857 TESTS OF ^{3}He WAVE-FUNCTIONS VIA THE ^{3}He(p,2p)d AND ^{3}He(p,2p)d* REACTIONS. Hu, C. Y. (California State Univ., Long Beach); Epstein, M. B.; Slaus, I.; Shannon, D. L. pp 648-650 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Calculations of ^{3}He wave functions have usually been tested by comparing them with the ^{3}He binding energy and the charge form factor derived from electron scattering. One variational calculation is tested using the additional information available from the ^{3}He(p,2p) reaction to see if these data are helpful in evaluating the validity of these wave functions. In the energy range between 35 and 155 MeV, the ^{3}He(p,2p)d and the ^{3}He(p,2p)d* reactions both show strong quasi-free p-p scattering. Comparison of these data with the plane wave impulse approximation (PWIA) indicates that this calculation can yield fairly good fits to the data if one uses different normalization constants for different incident energies and for the d and d* final states. How well the ^{3}He wave function fits the shape of the quasi-free scattering peak and the ratio of the ^{3}He(p,2p)d and ^{3}He(p,2p)d* cross sections is investigated. It is shown that ^{3}He(p,2p) quasi-free scattering provides a sensitive test for the tails of the wave functions and is less sensitive to the amount of S′ component used. (NL)

4858 ACCURATE DEUTERON–DEUTERON ELASTIC SCATTERING CROSS SECTIONS. Jarmie, N.; Jett, J. H. pp 659-662 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

As a part of a larger program of scattering measurements, deuteron–deuteron elastic scattering cross sections at 12.305 MeV with relative errors of 0.5% and a scale error of about 0.4% were measured. The energy was chosen to complement t + p scattering and reactions at 13.6 MeV. (auth)

4859 THEORY OF THE FOUR-PARTICLE SYSTEM WITH PAIR INTERACTIONS. Kharchenko, V. F. pp 663-666 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The bound states of the four-particle system with the total orbital momentum L = 0 is considered. Results for the binding energies of the ground and first excited 0^+-states of the two, three and four identical spinless particles are presented. (NL)

4860 NUCLEAR SPECTROSCOPY IN ^{4}He WITH TWO PARTICLE REACTIONS. Kilian, K.; Fritz, J.; Gueckel, F. A.; Kankowsky, R.; Neufert, A.; Niewisch, J.; Fick, D. pp 667-670 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An excitation function of the differential cross section and the analyzing power was measured in small energy steps for the elastic p-^{3}H scattering in the energy range of E_p = 4 to 12 MeV, using the polarized proton beam of the Erlangen EN-Tandem. With these angular distributions of the cross section and the analyzing power a phase shift analysis was performed, which led at each energy to a set of eigenphases and mixing parameters. An excitation function for ^{2}H(d,p) is also reported. (auth)

4861 DEUTERON-EXCHANGE POLE IN p–^{3}He SCATTERING. Kim, Y. E.; Tubis, A. pp 671-674 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Bolsterli and Hale (1972) have applied the so-called "modified phase-shift analysis" to a p–^{3}He elastic scattering data at 4.00, 5.51, 6.82 and 8.82 MeV. For l values 2, 3, 4 and 5, phase shifts were calculated from Born terms associated with deuteron and ($^1S_0$)np exchange graphs. The strengths of these exchange contributions are proportional to $|C|^2$ and $|C'|^2$, the normalization constants squared of the p-d and p-($^1S_0$)np tails respectively of the ^{3}He wave functions. It is shown that C may be extracted from the momentum space ^{3}He wave function by a very simple extrapolation procedure, and that the value of C, calculated from a fairly realistic ^{3}He wave function, differs by only 15% from that obtained empirically by BH. (auth)

4862 (p,2p) REACTION ON d, ^{3}He, AND ^{4}He AT 65 MeV. Pugh, H. G.; Cowley, A. A.; Roos, P. G.; Tibell, G.; Woody, R. III. pp 675-678 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The (p,2p) cross sections for d, ^{3}He, and ^{4}He were measured at 65 MeV. In addition to providing information on the energy dependence of the (p,2p) reaction, when compared to data at other energies, the data also provides information about the relative importance of multiple scattering as the number of target nucleons is increased. The data show the increasing importance of multiple scattering processes as the number of target nucleons is increased, and the need for a proper theoretical treatment of (p,2p) reactions at these energies in order to extract nuclear structure information is emphasized. (auth)

4863 PRELIMINARY MEASUREMENTS OF POLARIZATION TRANSFER IN ^{4}He[d(pol),d(pol)]^{4}He ELASTIC SCATTERING. Salzman, G. C.; Ohlsen, G. G.; Mitchell, C. K.; Grueebler, W.; Simon, W. G. pp 679-682 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The first polarization transfer measurements for deuteron ^{4}He

elastic scattering are reported. These measurements are sufficiently complete to allow an unambiguous determination of the scattering matrix, M, at the chosen energies and angles. This information can be used, for example, to make certain that a given set of energy-dependent phase shifts is on the correct "branch." This should greatly aid in confidently assigning positions, quantum numbers, and widths to the various states in ^{6}Li. (auth)

4864 EXPERIMENTAL TESTS ON THE PURITY OF NUCLEON–NUCLEON $^1S_0$ FINAL-STATE INTERACTION. van Dantzig, R.; Wielinga, B. J.; Wapstra, A. H.; Ijpenberg, A. D.; Slaus, I. pp 683-686 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An experimental test is reported on a necessary, model-independent condition for the validity of T-matrix factorization, which is a starting point for any FSI model. The following conclusions are drawn: The p-p low relative energy data ($T_{pp} < 2$ MeV) in the reaction $p + {}^3He \rightarrow d + (pp)$ at 69 MeV ^{3}He energy are not entirely consistent with the most general FSI diagram and therefore would not fully justify the factorization approximation, provided Coulomb effects are not responsible for anisotropy. The p-n low relative energy data ($T_{pn} < 0.5$ MeV) for the reaction $p + d \rightarrow p + (pn)$ at 26.5 MeV deuteron energy are fully consistent with the FSI diagram. (auth)

4865 ANGULAR DISTRIBUTIONS FOR THE REACTIONS $^3He + p \rightarrow d + (pp)$ AND $^3He + p \rightarrow p + (pd)$. Wielinga, B. J.; van Dantzig, R.; Mulder, K.; Ijpenberg, A. D.; Slaus, I. pp 687-690 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A study of the break-up of trions on nucleons can provide information both on two-nucleon scattering parameters and on the trion wave function. Extraction of such information requires a thorough understanding of the reaction mechanisms involved. In a kinematically complete way the reaction mechanisms are studied for break-up of ^{3}He particles on protons in various regions of phase space, emphasizing the angular dependence of pseudo two-body processes. The reaction $p + {}^3He \rightarrow p + p + d$ is dominated by the p-p FSI over a large region of phase space and can be described by the Watson–Migdal model. (auth)

4866 OPTICAL MODEL ANALYSIS OF NEUTRON–TRITIUM SCATTERING. Sherif, H. S.; Podmore, B. S. pp 691-694 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The applicability of the optical model to the n + t system was investigated. Optical model fits to the neutron polarization at 22.1 MeV and the differential cross section at 6, 9, 18, 19.5, 21 and 23 MeV are shown. In view of the quality of the fits to the observed data and the reasonable energy dependence of the parameters, it is concluded that the optical model can be applied as successfully to the n + t system as it was to processes involving heavier targets. (NL)

4867 FINAL STATE INTERACTION CALCULATION OF THE ANGULAR CORRELATION OF THE $J^\pi = 2^-$, T = 0 LEVEL OF ^{6}He. Haase, E. L.; Takeuchi, F.; Saylor, D. P. pp 720-724 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Previous calculations of the angular correlation for the $J^\pi = 2^-$, T = 0 level of ^{6}He in the $^6He(\alpha,\alpha'\gamma)$ reaction and a new approach which does not presuppose a sequential reaction mechanism are discussed. (auth)

4868 ANALYZING POWERS IN THE $^3He[d(pol)p]^4He$ REACTION AT ENERGIES LESS THAN 1.0 MeV. Simon, W. G.; Mitchell, C. K.; Ohlsen, G. G. pp 735-738 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The results of measurements of the analyzing tensors A_y, A_{xz}, and $\frac{1}{2}(A_{xx}-A_{yy})$ for the $^3He(d,p)^4He$ reaction at a center-of-mass angle $\theta = 54.7°$ for energies between 366 and 1090 keV, and of the tensor A_{zz} at $\theta = 0°$ in the same energy range are reported. (auth)

4869 TRINUCLEON PROPERTIES FROM A COMPLETE SOLUTION OF THE FADDEEV EQUATIONS WITH THE REID SOFT-CORE POTENTIAL. Brandenburg, R. A. (Los Alamos Scientific Lab., NM); Kim, Y. E.; Tubis, A. Phys. Lett.; 49B: No. 3, 205-208(15 Apr 1974).

The trinucleon bound-state energy E_B, wave function, and charge from factor are calculated from a complete solution of the Faddeev equations with the full Reid soft-core potential (RSCP). $E_B = 6.9$ MeV, P(S) = 89.58%, P(S′) = 1.60%, P(D) = 8.77%, and P(P) = 0.05% are found in good agreement with the results of a previous calculation using only the $^1S_0$, $^3S_1$–$^3D_1$ components of the RSCP. The calculated $|F_{ch}(Q^2)|$ of ^{3}He has a minimum at about $Q^2 = 18$ fm^{-2}. (auth)

4870 ELECTRIC ^{3}H AND ^{3}He FORM FACTORS FOR REALISTIC POTENTIALS. Demin, V. F.; Ezhov, S. N.; Rogov, Yu. K.; Zakharchenko, I. E. (Inst. of Atomic Energy, Moscow). Phys. Lett.; 49B: No. 3, 217-218(15 Apr 1974).

Electric ^{3}H and ^{3}He form factors for the Reid, Bressel–Kerman–Rouben and super soft-core potentials have been calculated with the hyperspherical function method. (auth)

4871 ELASTIC SCATTERING OF π^+ AND π^- ON ^{4}He AT 68 AND 154 MeV. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Kulyukin, M. M.; Lyashenko, V. I.; Pontecorvo, G. B.; Shcherbakov, Yu. A.; Albu, M.; Besliu, T.; Mihul, A.; Nichitiu, F.; Garfagnini, R.; Piragino, G. Nuovo Cim.; 21A: No. 1, 168-178(1 May 1974).

The differential cross sections for elastic scattering of π^+ and π^- mesons on ^{4}He were measured at 68 and 154 MeV with a high-pressure helium streamer chamber. A phase-shift analysis (ACE method) has been carried out. The importance of the high partial waves is discussed. (auth)

4872 OFF-MASS-SHELL EFFECTS IN DEUTERON BREAKUP BY PION AT LOW ENERGIES. Ferreira, E. M. (Pontificia Universidade Catolica, Rio de Janeiro); Rosa, L. P.; Thome, Z. D. Nuovo Cim.; 21A: No. 1, 187-196(1 May 1974).

The $\pi d \rightarrow \pi pn$ differential cross section near the 33 resonance is calculated considering the Fermi motion of the nucleons inside the deuteron and the off-mass-shell effect. The off-mass-shell extension of the πN amplitude is made using a separable potential model. A comparison with experimental data is presented, with a brief discussion. (auth)

4873 CONNECTION BETWEEN THE LEVEL STRUCTURE OF ^{4}He AND (^{6}He, ^{6}Li). Schroeder, H.; Kern, K. K.; Kilian, K.; Kreisel, K.; Fick, D. pp 1002-1005 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In two particle experiments concerning the five nucleon system scattering states had been proposed assuming compound reaction mechanism. The three particle reactions like t(d,n)pt or d(γ,p)pt are investigated to get information about the final state interaction of two emitted particles. Commonly the three particle reaction mechanism is supposed to be a direct one. It is shown that the contrary—a compound nucleus reaction mechanism—should be expected for the five nucleon system in the energy range where most of the three particle experiments had been done ($E_x \leq 30$ MeV). (auth)

4874 NEGATIVE PION CAPTURE IN HELIUM. Lim, T. K. pp 896-897 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It is now gaining wide acceptance that the absorption of pions in nuclei is a two-nucleon process. For light nuclei, two models have been extensively used to describe pion absorption, the Eckstein model and the Cheon-Koltun-Reitan model. Although both models were used in the description of pion capture in ^{3}He and ^{4}He, to date, there has been no study of the relative merits of the two. The first step in an attempt to do this, namely a consistency check on the Eckstein model in the calculation of the capture rates for ^{3}He and ^{4}He, is reported. (auth)

4875 MUON-CAPTURE IN DEUTERIUM IN THE ELEMENTARY PARTICLE TREATMENT. Mintz, S. L. pp 902-905 of

Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A calculation is presented of the rates for muon-capture in deuterium, $\mu^- + d \rightarrow n + n + \nu_\mu$, from the doublet and quartet states in the elementary particle treatment. Treatment of this process is complicated by the presence of two hadrons in the final state. (auth)

4876 NEUTRINO DISINTEGRATION OF THE DEUTERON. O'Connell, J. S. pp 906-909 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In the electromagnetic breakup of the deuteron at low energies, effective-range theory is known to provide simple, reliable wave functions for the $^3S_1$ bound state and the $^1S_0$ continuum state. The total and differential cross sections for this process are found. The energy spectrum of electrons for 43 MeV incident energy peaks close to the highest energy available because of the strong interaction between $^1S_0$ protons at low relative momenta. The angular distribution of all electrons, averaged over the μ^+ neutrino spectrum is shown and indicates that the weak magnetism term enhances the backward peaking. The values of spectrum-averaged cross sections of the deuteron and other targets are shown. (NL)

4877 ELECTRON SCATTERING AND FEW NUCLEON SYSTEMS. Amaldi, U. pp 839-860 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Deuterium, three nucleon systems, and ^{4}H are considered, and the experimental information available on the charge and magnetic form factors and on electrodisintegration processes is presented. When appropriate, the output of these calculations is reviewed without any claim of completeness but with the purpose of outlining the present explanation, or better lack of explanation, of the high momentum behavior of the form factors. (auth)

4878 WEAK INTERACTION OF LEPTONS WITH FEW-NUCLEON SYSTEM: MESON AND NUCLEON-ISOBAR. Primakoff, H. pp 827-838 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The several actual and potential discrepancies between experiment and precise NOIA (nucleons only impulse-approximation) calculations for the various weak processes in the few-nucleon nuclei: d, ^{3}H, ^{3}He and ^{4}He, are discussed. Those weak processes in the few-nucleon nuclei which may be expected to reveal most directly any actually existing "exotic" hadron weak currents and hence simultaneously provide unequivocal evidence for the intranuclear presence of mesons and nucleon-isobars are discussed. (NL)

4879 MESIC INTERACTIONS IN VERY LIGHT NUCLEI. Eisenberg, J. M. pp 796-826 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

This review deals primarily with the scattering, absorption and production of pions and kaons on systems with nucleon number A = 2, 3 or 4; it is, in the main, restricted to processes involving only strongly interacting particles. The review deals almost exclusively with the work of the last few years in this area. (auth)

4880 PHOTON SPECTRA FROM PION ABSORPTION ON ^{3}He AND ^{6}Li. Baer, H. W.; Birstirlich, J. A.; Crowe, K. M.; Helland, J. A.; Trucel, P. pp 877-881 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Preliminary results of a high resolution study of the photon spectra in the 50 to 150 MeV region associated with stopped π^- absorption on ^{3}He and ^{6}Li are reported. (auth)

4881 3-3 RESONANCE IN THE PHOTOPRODUCTION ^{3}He$(\gamma,\pi)^3$H. Bachelier, D.; Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Radvanyi, P. (Institut de Physique Nucleaire, Orsay, France). pp 873-876 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The experiment compares, in the region of the first resonance, the coherent photoproduction of π^+ on ^{3}He with the elementary photoproduction on the free proton. The experiment was performed with the bremsstrahlung photon beam of the new Saclay linear electron accelerator. In a first series of experiments the cross sections versus E_γ, at fixed values of q^2 were also made at a fixed angle $\theta_{\pi CM}$ versus q^2 up to 13 fm^{-2}. (auth)

4882 ANOMALY IN THE ^{4}He$(\gamma,p\pi^-)$ REACTION AROUND THE $\Delta(1236)$ RESONANCE. Argan, P.; Audit, G.; de Botton, N.; Laget, J. M.; Martin, J.; Schuhl, C.; Tamas, G. pp 869-872 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The reaction: $\gamma + {}^4\text{He} \rightarrow p + \pi^- + (ppn)$ is studied for a given recoil momentum $\vec{p}_R$ of the residual (ppn). For low values of p_R the nucleus may be described correctly by the independent particle model, and one may use the impulse approximation. In this model one has $-\vec{p}_R = \vec{p}_0$, where $\vec{p}_0$ is the momentum of the target neutron before the interaction. Then the cross section for the reaction as a function of the invariant mass Q of the proton-pion pair can be accurately predicted from the cross section for the elementary reaction $\gamma + n \rightarrow p + \pi^-$ and the nucleon momentum distribution. In a search for a departure from the predictions of this model, the photoproduction was studied at high values of p_R. The experimental and theoretical distorted momentum distributions are compared, agreement is good for low recoil momentum values. The anomaly found at high recoil momentum is attributed to a resonant process with two or more nucleons. (auth)

4883 HIGH ENERGY ^{3}H$(\alpha,\alpha p)$n REACTION. Nakamura, H. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A223: No. 3, 599-615(1974).

The ^{3}H$(\alpha,\alpha p)$n reactions at 78.3 and 165 MeV lab energy are analyzed by the semi-phenomenological method which was introduced previously. The same parameter set is adopted for both the 78.3 and 165 MeV cases. The agreement with data is excellent, as well as in low energy cases. The results indicate strongly that the even parity (D- and G-waves) reactions are very strong while the odd parity (P- and F-waves) ones are definitely weak. (auth)

4884 PHOTOPRODUCTION OF POSITIVE PIONS FROM ^{3}He. Janecek, P. (Tekniska Hoegskolan, Lund, Sweden). Phys. Scr.; 8: No. 6, 229-230(Dec 1973).

The impulse approximation and photoproduction amplitudes given by the dispersion theory were used to calculate the differential cross section of the reaction ^{3}H$(\gamma,\pi^+)^3$H. Results of the calculations are compared with the experimental data obtained recently at Orsay. (auth)

4885 CALCULATION FOR POLARIZATION VALUES OF ELASTIC p-^{3}He SCATTERING. Heiss, P.; Hackenbroich, H. H. pp 644-647 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A theoretical investigation of the elastic p-^{3}He scattering was performed. This investigation is based on a multichannel resonating group calculation and uses a Hamiltonian which includes nucleon-nucleon spin-orbit and tensor forces in addition to central forces. Hence not only cross sections but also polarization values could be obtained. The experimental results for the ^{3}He polarization and the spin correlation parameter A_{yy} are compared to the calculated values. Agreement between experimental and calculated ^{3}He polarization values is good. (BRH)

4886 TWO-BODY PHOTODISINTEGRATION CROSS SECTIONS OF ^{3}He AND ^{4}He IN THE REGION OF $\Delta(1236)$ Argan, P.; Audit, G.; de Botton, N.; Faure, J. L.; Laget, J. M.; Martin, J.;

Schuhl, C.; Tamas, G. pp 865-868 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The two-body photodisintegration cross section of deuterium is characterized by an enhancement around 280 MeV. This feature was analyzed previously with a phenomenological model which takes into account pion photoproduction and reabsorption. It is of interest to study the behavior of few nucleons nuclei in order to see if such a picture can be extended. Differential cross sections were measured at 90 and 120° deuteron/triton center of mass angles, in the photon energy region ranging from 200 up to 350 MeV for the two reactions $\gamma + {}^3He \rightarrow d + p$ and $\gamma + {}^4He \rightarrow t + p$. (auth)

4887 INVESTIGATION OF FOUR- AND FIVE-NUCLEON SYSTEMS IN THE TRANSLATIONAL-INVARIANT OSCILLATOR BASIS. Gogsadze, G. Sh.; Kopaleishvili, T. I. (Tbilissi State Univ., USSR). Yadern. Fiz.; 19: No. 3, 539-551(Mar 1974). (In Russian).

In the translational-invariant oscillator basis an account is fulfilled of configurations with the number of oscillator quanta N = 3 in the calculations of: energy levels with negative parity for nuclei with A = 4 and 5; the γ-absorption, radiative π^-- and μ^--capture processes on the ^{4}He nucleus. Dependence of the obtained results on the realistic potentials used in calculations is investigated. The theoretical results are compared with the experimental data. The efficiency of using the basis in study of properties of four- and five-nucleon system is shown. (auth)

4888 METHOD OF INTEGRAL EQUATIONS IN THE 4-NUCLEON PROBLEM. Narodetskii, I. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 3, 552-569(Mar 1974). (In Russian).

The method of integral equations is applied to the 4-nucleon bound state problem. The integral equations proposed by Yakubovsky are considered. The pairing potentials are chosen in the form of the separable potentials of Yamaguchi type. Then the problem is reduced to the solution of the system of two-dimensional integral equations. This system can be substituted by the system of one-dimensional integral equations by introducing the separable expansion for the amplitudes of the 3 * 1 and 2 * 2 subsystems which are involved in the kernel of the integral equations. The separable expansion of the Hilbert–Schmidt kind is used and it is shown that this method leads to a rapid numerous convergence in the 4-nucleon problem. The system of the one-dimensional integral equations is solved for the states corresponding to the α-particle quantum numbers S = T = 0. The calculated binding energy of the α particle equals –45.73 MeV. The excited 0^+ level manifests itself as a bound state which is 0.66 MeV lower than the pT threshold. In conclusion the accuracy of various approximations in the 4-nucleon problem is discussed. (auth)

4889 DOES AN l-INDEPENDENT $\alpha-\alpha$ INTERACTION EXIST. Rahman, M.; Ali, S.; Afzal, S. A. pp 994-997 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Since from the phenomenological point of view, the l-dependence of the $\alpha-\alpha$ interaction has been studied with only certain chosen shapes (in fact, in the past mainly square well and Gaussian potentials have been used), the question remains whether this l-dependence is true for all assumed shapes and flexibilities of the $\alpha-\alpha$ potentials. It is in this context that the present analysis was performed with Woods–Saxon form. The result obtained, e.g., l-independence of the $\alpha-\alpha$ interaction is, however, contrary to past finding. (auth)

4890 PHOTONEUTRON ANGULAR DISTRIBUTION FOR ^{4}He. Irish, J. D.; Berman, B. L.; Johnson, R. G.; Thomas, B. J.; McNeill, K. G.; Jury, J. W. pp 888-891 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Recent measurements of the total and 90° differential photoneutron cross sections for ^{4}He in the giant-resonance region have demonstrated the need for a detailed measurement of the complete photoneutron angular distribution for that nucleus, in order to relate the total to the differential cross sections, and to delineate the magnitude and energy dependence of the E2 cross section. Such an experiment was performed using a pulsed bremsstrahlung beam and the neutron time-of-flight facility at the University of Toronto Electron Linear Accelerator. Differential cross sections were measured at six angles, ranging from 53 to 143°, for photon energies from threshold to 33 MeV (laboratory neutron energies up to ~9 MeV). (auth)

4891 BREAK-UP OF $^{12}C^*$ INTO THREE ALPHAS AT E_X = 18.36 MeV. Goulard, G.; Turcotte, G. pp 964-967 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An analysis is reported of the reaction $^{11}B(p,\alpha)2\alpha$ at a proton bombarding energy of 2.65 MeV by taking a sequential mechanism $^{11}B + p \rightarrow {}^{12}C^* \rightarrow \alpha_k + {}^8Be \rightarrow \alpha_k + \alpha_i + \alpha_j$. For this process, the authors have computed the differential cross-section in the laboratory σ_L obtained in a previous paper, and compared it with the experiments of Bronson et al. (auth)

4892 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS: POST-DEADLINE PAPERS. pp 714-722 of Proceedings of the International Conference on Nuclear Physics. Vol. 1 de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

The following nine post-deadline papers were included in the conference proceedings: A measurement of the spin–spin correlation coefficient in ^{2}H–^{1}H scattering; Thomas–Fermi method for the surface of the nucleus; Light nuclei from ternary fission; Density fluctuations and nuclear structure; Neutron activation of pre-Chalcolithic western Mediterranean obsidian; T = 2 level in ^{30}P as a compound nuclear resonance; Normal-parity states in A = 35 and 34 nuclei; Shell model calculation on the Cu isotopes; and Magnetic moment scattering of protons. (RWR)

4893 ELECTROMAGNETIC EXCITATION OF HIGH-ENERGY NUCLEAR STATES. Tzara, C. pp 529-540 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The energy range considered begins above the giant resonances. The definition of nuclear excited states is more involved at high energy than it is for the bound states or even for states manifested in the giant resonances. Conceptually there is no difficulty; but in observation of these states one must remember that the eigenstates are observed only at large distances from the nucleus, and in some of the numerous channels available. Use of weakly interacting probes means that a state in the continuum can in principle be studied in the same manner as a bound state. Excitation of the deuteron, the three-nucleon system, and ^{4}He is discussed. Finally, photoproduction of pions on complex nuclei and total absorption of photons and inelastic electron scattering are briefly mentioned. (9 figures) (RWR)

4894 $P_{\frac{3}{2}}$ AND $P_{\frac{1}{2}}$ STATES OF ^{5}He AND ^{5}Li NUCLEI BY n + ^{4}He AND p + ^{4}He SCATTERING. Kraus, L.; Linck, I. (CRN, Cronenbourg, France). Nucl. Phys.; A224: No. 1, 45-60(1974). (In French).

Differential cross sections were measured for ^{4}He + p elastic scattering in the angular range from 30 to 165° and at incident energies ranging from 0.5 to 3 MeV. These data and previously existing cross section and polarization data are analyzed in the framework of the Humblet–Rosenfeld S-matrix theory. The characteristics of the $P_{\frac{3}{2}}$ and $P_{\frac{1}{2}}$ ^{5}Li levels are deduced. A similar analysis is performed for the ^{4}He + n elastic scattering and the spectroscopic characteristics of the mirror nucleus ^{5}He P-levels are then deduced. These results seem to be less ambiguous than those of phase shift R-matrix analyses and are in good agreement with nuclear reactions results. The spin-orbit splitting is found to be of the order of 2.1 MeV for the two nuclei. Mass excesses of ^{5}He and ^{5}Li are found to be 11.275 ± 0.05 MeV and 11.313 ± 0.1 MeV respectively. (auth)

4895 ^{2}H + p BREAK-UP REACTION OFF THE ENERGY SHELL AT 58.5 MeV. Durand, J. L.; Bilaniuk, O. M.; Perrin, C. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A224: No. 1, 77-85(1974).

Differential cross sections were measured for ^{2}H(p,2p) break-up off the energy shell at 58.5 MeV. Data were analyzed with exact calculations using the Ebenhöh code restricted to S-wave N-N forces and with calculations based on the truncation of the Faddeev rescattering series allowing for S-, P- and D-wave N-N interactions. (auth)

4896 DISPERSION K-MATRIX APPROACH TO NUCLEAR REACTIONS AND ITS APPLICATION TO Nα SCATTERING. Baryshnickov, A. G.; Blokhintsev, L. D.; Safronov, A. N.; Turovtsev, V. V. (Moscow State Univ.). Nucl. Phys.; A224: No. 1, 61-76(1974).

A description of nuclear reactions is suggested based on the assumption that the main contribution to the reaction K-matrix elements, regarded as analytic functions of the variable $z = \cos\vartheta$ (ϑ being the scattering angle), comes from the singularities of these functions which are nearest to the physical region. Analytic properties of K-matrix elements with respect to z are discussed. As an illustration, elastic Nα scattering is examined, and vertex constants values are found for the vertices $\alpha \rightleftharpoons t + p$ and $\alpha \rightleftharpoons \tau + n$. (auth)

4897 MEASUREMENT OF THE ANALYZING POWER OF THE ^{3}He(d,p)^{4}He REACTION BELOW 1 MeV. Garrett, R.; Lindstrom, W. W. (Univ. of Basel). Nucl. Phys.; A224: No. 1, 186-198(1974).

The analyzing powers iT_{11}, T_{20}, T_{21} and T_{22} were measured for the reaction ^{3}He(d,p)^{4}He at laboratory energies of 344, 465 and 727 keV. A polarized deuteron beam was used with quantization axis oriented perpendicular to and at 54.7° to the incident beam direction. With semi-conductor proton detectors in two perpendicular planes all four analyzing powers could be determined. The beam polarization was determined using the ^{3}H(d,n)^{4}He reaction at a mean energy of 130 keV. The uncertainty in this analyzing power and the effect on the results is discussed. The analyzing powers were fitted to a Legendre polynomial expansion to four or five terms and the resulting coefficients tabulated. The results indicate that d-waves contribute to the reaction only through the ^{4}D entrance channel and their contribution falls off both above and below the $\frac{3}{2}^+$ resonance at 430 keV. (auth)

4898 BOUNDS ON THE OFF-SHELL VARIATION OF THE TRITON BINDING ENERGY FOR PHASE-EQUIVALENT POTENTIALS OF RANK-TWO. McGurk, N. J.; Fiedeldey, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 445-448 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A prescription for generating a family of elastically equivalent separable potentials of rank-two by means of a solution of the inverse scattering problem has been given previously. If the complete interaction is given by $V(k,k') = (1/2\pi^2 \cdot \hbar^2/m)\,[-g(k)\,g(k') + h(k)\,h(k')]$, the form factor g(k) of the attractive part $V_\phi(k,k')$ subject to weak restrictions can be chosen arbitrarily. If E_D and E_B are the binding energies of V(k,k') and $V_\phi(k,k')$, respectively ($E_B = -\hbar^2 k_B^2/m$), then h(k) can be determined so that V(k,k') generates a given phase shift δ(k) and k_D. If $\delta_\phi(k)$ is the phase shift of $V_\phi(k,k')$ alone, then $\delta_\phi(k) > \delta(k)$ and also $k_B \geq k_D$. g(k) is chosen to have the Yamaguchi form, $g(k) = \gamma(k^2 + \beta^2)$. For a given range of β^{-1}, the upper bound on the binding energy is obtained from the zero-range critical potential, and the lower bound, by the lower limit potential. (auth)

4899 NON-VARIATIONAL CALCULATION OF THE TRITON BINDING ENERGY WITH HARD-CORE SPIN-DEPENDENT LOCAL POTENTIALS. Maheshwari, C.; Lagu, A. V.; Mathur, V. S.; Sood, P. C. (Banaras Hindu Univ., India). pp 437-440 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A separable two-body t-matrix brings about considerable simplification in the three-body equations. While the separability of the t-matrix is automatic for non-local separable potentials, some separable approximation has to be used in the case of local potentials. One such approach is the "unitary pole approximation" (UPA), which has recently been shown to correspond to the one-term approximation of the unitary pole expansion (UPE) for the off-shell elements of the t-matrix. The UPA approach, which is computationally simple and has shown promise to be useful for potentials with spin-dependence as well, has so far not been used for three-body calculations with hard-core potentials. The results of such a study are reported. It is observed that the introduction of a hard core causes comparatively less reduction in the binding energy in a UPA calculation than it does in a variational calculation. (INIS)

4900 NEARLY SEPARABLE POTENTIALS IN THE TRITON. Erens, G.; Fiedeldey, H. (Univ. of Pretoria). pp 399-402 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Attention is focused on the bound-state properties of the triton for nearly separable potentials. The dependence of the binding energy (E_T) on the strength of the interaction (s) has been calculated for the following potentials: (1) the δ-shell potential; (2) the MIRT potential; (3) a really purely attractive square-well potential; (4) the Malfliet–Tjon potential with a soft core repulsion; (5) Tabakin's separable potential of rank two; and (6) a purely attractive Yukawa potential which is definitely not nearly separable. It is argued that local potentials with realistic phase shifts have much more in common with certain classes of non-local potentials than is commonly accepted. (INIS)

4901 COMPARISON OF THE SENSITIVITY OF THE BINDING ENERGIES OF THE TRITON AND OF NUCLEAR MATTER TO THE HIGH ENERGY PHASE SHIFT. Fiedeldey, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 407-410 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It has been shown previously that the binding energy of the triton E_T can be very sensitive to the phase shift δ(k) at high energies for separable potentials of rank two (and higher rank) and that this was also the case with the binding energy of nuclear matter E_{NM}. For critical potentials, i.e. with $E_B = E_D$ (where E_B is the binding energy of the attractive part alone), E_{NM} depends only weakly on $\delta_c(k)$. The strongest dependence of E_{NM} on $\delta_c(k)$ occurs for potentials with $E_B \gg E_D$. In previous investigations of the sensitivity of E_T to variations in $\delta_c(k)$ the author did not consider the limiting potentials with $E_B = E_D$ and $E_B \gg E_D$. The highest values of E_T and the lowest values of E_{NM} occur for the critical potentials ($E_B = E_D$). This indicates that a different mechanism operates in the triton and in nuclear matter and this may also affect the sensitivity of E_{NM} and E_T to $\delta_c(k)$ differently. A physical explanation of the results is also given in terms of the T-matrix. (INIS)

4902 CAPABILITY OF THE HYPERSPHERICAL EXPANSION METHOD FOR SOLVING THE TRINUCLEON BOUND STATES. Fabre de la Ripelle, M. (Paris Univ., Orsay, France). pp 403-406 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

An approximation method enabling one to solve the many body Schroedinger equation $(H - E)\,\psi = 0$ consists in transforming this partial differential equation into an infinite set of one-dimensional coupled differential equations, a finite number of which being afterward numerically integrated. The degeneracy of the hyperspherical harmonics (h.h.) for a global quantum number L is so large that it is necessary to reduce the number of significant coupled equations so as to increase the convergence of the method by integrating a small enough number of equations. The construction of a basis, each element of which groups together the contribution of as many as possible h.h., is discussed. A study of the convergence is made for the case of the trinucleons for soft-core potentials for which accurate variational results are known. Good agreement with the variational results is obtained. (INIS)

4903 APPLICATION OF THE HYPERSPHERICAL FUNCTION METHOD TO THE CALCULATION OF THE TRITON BINDING ENERGY WITH REALISTIC TWO-NUCLEON POTENTIALS. Bruinsma, J. (Vrije Universiteit, Amsterdam); van Wageningen, R.; Visschers, J. L. pp 368-371 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A number of calculations have been carried out to obtain the triton binding energy and wave function with realistic nucleon–nucleon forces. From their calculations Delves and Hennell (1972) concluded that the discrepancies in the doublet scattering length, the Coulomb energy, and the minimum in the ^{3}He charge form factor can be removed with a potential which has a softer but larger core than the Hamada–Johnston potential. Thus the authors calculate the three-body properties with a super-soft-core potential (SSC) derived by De Tourreil and Sprung. The formalism to calculate the three-nucleon properties with variational calculations has been extended for realistic potentials. The only remaining restrictions are locality, energy independence and finiteness,

except in the origin, of the two-nucleon interaction. The particles need not be identical and may have arbitrary spins and isospins. The binding energy converges much better for the SSC than for the Reid SC potential. It is concluded that the binding energy for the SSC is significantly smaller than for the Reid SC. (INIS)

4904 MESON-EXCHANGE CONTRIBUTIONS TO ^{3}H BETA DECAY AND ^{3}H, ^{3}He MAGNETIC MOMENTS. Kim, Y. E. (Purdue Univ., Lafayette, IN); Fischbach, E.; Harper, E. P.; Tubis, A.; Cheng, W. K.; Rho, M. pp 433-436 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Calculations are reported of the one-pion-exchange correction to the triton β-decay matrix element, using the Cheng phenomenological model and the method of Chemtob and Rho, which is based directly on low-energy theorems. The ^{3}H, ^{3}He wave functions are obtained from a direct solution of the Faddeev equations in which the nucleon-nucleon interaction (effective in the $^1S_0$ and $^3S_1-^3D_1$ states) is given by the Reid soft-core potential. The ^{3}H binding energy is 6.7 MeV, and the wave function components have the probabilities P(S) = 89.7%, P(S') = 1.7% and P(D) = 8.6%. It is also shown that the two-body one-pion exchange contributions to the isovector magnetic moment μ_V, calculated by Chemtob and Rho, account for most of the discrepancy between the experimental ^{3}H, ^{3}He magnetic moments and single-particle values. (auth)

4905 THREE-NUCLEON GROUND STATE PROPERTIES FOR REALISTIC LOCAL AND NON-LOCAL NUCLEON-NUCLEON INTERACTIONS. Malfliet, R. A. (State Univ., Groningen, Netherlands); Tjon, J. A. pp 441-444 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The three-nucleon bound-state properties for a Reid potential having a soft-core repulsion and for the less known Rouben potential are compared. They were calculated by solving the Faddeev equations after performing the necessary angular momentum algebra and using a special computational technique which makes the problem numerically manageable. The input consists of the nucleon-nucleon potentials, with the singlet part restricted to $l = 0$ and the triplet part, to $l = 0$ and $l = 2$ plus the mixing between them as a consequence of the presence of tensor forces. Since the Rouben potential is not directly Fourier transformable into momentum space, the necessary Fourier transformation was performed numerically. As a check of this procedure the singlet and triplet phase shifts were recalculated and found to be in good agreement with the quoted ones. (auth)

4906 GROUND STATE OBSERVABLES OF ^{3}He AND ^{3}H. Nunberg, P. (Comitato Nazionale per l'Energia Nucleare, Rome); Prosperi, D.; Pace, E. pp 449-452 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In a recent paper the authors computed the binding energy and charge radii of the trinucleon by using a smoothed version of the Bressel-Kerman-Rouben potential to which a short-range nonlocal separable core was added (V_R). The results were very similar to those obtained by other groups using much harder potentials such as Hamada-Johnston, Reid soft-core and B-K-R, the main difference consisting in a rather low D-state probability. The analysis of V_R is continued by including the computation of charge form factors and studying the local potential (V_{RL}) which is obtained from V_R by omitting the nonlocal core. This potential is still very soft, although a little less so than V_R; it also fits the two-body data rather well ($\chi^2 = 5.6$ for p-p and 2.5 for n-p), and it yields a more usual deuteron D-state probability (2.9% for V_R, 5.9% for V_{RL}). The method employed essentially consists of the diagonalization of the trinucleon Hamiltonian in a basis of L-S coupled states built from harmonic oscillator wave functions in the two intrinsic variables. The binding energy and charge radii of the trinucleons are calculated. The results are in quite good agreement with experiment, although the height of the secondary maximum cannot be reproduced, in common with other realistic potentials. (INIS)

4907 SENSITIVITY OF ^{3}H AND ^{3}He PROPERTIES ON LOW-ENERGY NUCLEON-NUCLEON SCATTERING PARAMETERS, USING A DELTA-SHELL NUCLEON-NUCLEON POTENTIAL. von Wageningen, R. (Vrije Universiteit, Amsterdam); Stuivenberg, J. H.; Bruinsma, J.; Erens, G. pp 453-456 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The sensitivity of several three-nucleon bound-state properties on each of the low-energy nucleon-nucleon scattering parameters, viz., a_s, a_t, r_{0s}, r_{0t}, is examined. The delta-shell potential is particularly well-suited for several reasons. Firstly, with an appropriate choice of the potential parameters an amazingly good fit to the $^1S_0$ and $^3S_1$ phase shifts is obtained. Secondly, because the potential is local, several three-nucleon properties can be calculated easily, by using the hyperspherical harmonics formalism. On the other hand, the $l = 0$ part of the potential is exactly separable and thus suited for solving the Mitra equations. The binding energy, r.m.s. radius and Coulomb energy of the triton are calculated. It is found that these properties are much more sensitive to variations in the effective ranges than in the scattering lengths, with almost no dependence on the singlet scattering length. (INIS)

4908 MEASUREMENT OF DIFFERENTIAL CROSS SECTION FOR n-d ELASTIC SCATTERING AT 128 MeV. das Gupta, S. S. (Queen Mary Coll., London); Edgington, J. A.; Blair, I. M.; McNaughton, M. W.; Bonner, B. E.; Stewart, N. M. pp 457-459 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Using the slow spill time-of-flight system, the authors have taken data on the elastic scattering of neutrons by deuterons, at seventeen angles in an energy interval between 100 and 150 MeV. Distinct methods were used in two overlapping angular regions. Between 89.5° and 168° cm, deuterons from a liquid deuterium target were detected by using five counter telescopes simultaneously. Between 30.5° and 110° cm a scintillating target of deuterated cyclohexane was used; the scattered neutrons were detected in an array of five scintillation counters. The data are in good agreement in the overlap region. There is no sign of the pronounced minimum found at 40 MeV by Romero et al. The results are compared to a calculation using a simple impulse approximation, including the effect of the deuteron D-state and the contribution of the pick-up reaction. (INIS)

4909 VECTOR TO TENSOR POLARIZATION TRANSFER IN PROTON-DEUTERON ELASTIC SCATTERING. Ohlsen, G. G.; Mitchell, C. K.; Salzman, G. C. (Los Alamos Scientific Lab., NM). pp 460-463 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Measurements are reported of the second-rank polarization of the deuterons which recoil from proton-deuteron elastic scattering in cases where the incident protons are polarized. A 50-150 nA beam of ~90% polarized protons from the Los Alamos Scientific Laboratory (LASL) Lamb-shift polarized source-tandem accelerator installation was used to bombard a 6.4-mm diameter liquid-nitrogen-cooled D_2 target cell operating at a pressure of 6.2 atm. Recoil deuterons were slowed by means of suitable aluminum foils to ~800 keV before entering a ^{3}He cell where the ^{3}He(d,p)^{4}He reaction was used to determine the deuteron tensor polarization. The analyzing power, polarization functions and transfer coefficients are given for Ep from 3.6 to 9.1 MeV. (auth)

4910 ANALYSIS OF NUCLEON-DEUTERON SCATTERING LEADING TO A MEASUREMENT OF THE DEUTERON'S D-STATE PERCENTAGE. Remler, E. A.; Miller, R. A. (Coll. of William and Mary, Williamsburg, VA). pp 464-467 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

As part of a more comprehensive analysis of nucleon-deuteron elastic scattering data at intermediate energies, the authors have used available data at 146 MeV to attempt an approximate evaluation of the D-state percentage, P_D. They begin with a sketch of the general procedure and then discuss the results, particularly the evaluation of P_D. The one-nucleon-exchange contribution to the elastic neutron-deuteron transition matrix, T_X, and the single-scattering contribution, T_I, were evaluated. While there are very many other types of processes involved in elastic scattering, the most important remaining ones, at these energies, are undoubtedly

simply higher-order multiple scatterings. Out of the corresponding set of contributions to the transition matrix, $T_2, T_3, \ldots$, only T_2 has appreciable angular dependence. The contribution from these higher-order terms is calculated as a pure S-wave term Ts, containing four free parameters. It is assumed that all contributions to T are isotopic in the center-of-mass system. The effect of including the Ts term is considerable. On the basis of experimental data and use of a Humberston–Wallace wave function, the D-state percentage lies between 7 and 9%. (INIS)

4911 DIFFERENTIAL CROSS SECTION FOR THE ELASTIC SCATTERING OF 14.1 MeV NEUTRONS BY DEUTERONS. Shirato, S.; Koori, N. (Rikkyo Univ., Tokyo). pp 472–474 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The authors have re-measured the differential cross section for elastic n–d scattering, as their previous results gave a somewhat shallow minimum in the valley region, around 120° c.m. scattering angle, in comparison to other experiments. Legendre polynomials of up to 10th order are used to fit the data. The value of the total elastic cross section is 623 ± 5 mb, obtained by integration. The total scattering cross section is 806 ± 6 mb. The results are in good agreement with other data. (INIS)

4912 PROTON TOTAL REACTION CROSS SECTION MEASUREMENTS FOR DEUTERIUM IN THE ENERGY RANGE 20 TO 50 MeV. Carlson, R. F. (Univ. of Redlands, CA); Slaus, I.; Tin, S. Y.; van Oers, W. T. H.; Doherty, P.; Margaziotis, D. J. pp 475–478 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It has been suggested that the method to determine the N–d total reaction cross section (σ_r) by subtracting the total elastic nuclear cross section ($\sigma_{tot\ el}$) from the N–d total cross section (σ_{tot}) is not very reliable at energies below 100 MeV. In this paper measurement of total reaction cross sections in the energy range 2–50 MeV by using the total reaction cross section experimental setup of the UCLA sector-focused cyclotron is reported. It is concluded that accurate total reaction cross sections can help in distinguishing between calculations using the same approach but different two-nucleon interactions. (INIS)

4913 OFF-ENERGY-SHELL NUCLEON–NUCLEON T-MATRIX AND PROPERTIES OF ^{3}H AND ^{3}He. Kim, Y. E.; Harper, E. P.; Tubis, A. (Purdue Univ., Lafayette, IN). pp 429–432 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The Faddeev formalism is used to investigate the variation of the trinucleon binding energy and electromagnetic form factors with phase-equivalent transformations of the Reid soft-core potential. The transformed nucleon–nucleon interactions used in the calculations are the same as, or slight variations of, those used by Haftel and Tabakin (1971). The comparison of the results with those of Haftel and Tabakin give a good indication of the relative magnitudes of off-shell effects in nuclear matter and in the trinucleon system. It is seen that the properties of ^{3}H and ^{3}He are generally less sensitive to variations of the off-shell nucleon–nucleon T-matrix than are those of nuclear matter. (INIS)

4914 ^{3}He–^{3}H ENERGY DIFFERENCE AND ISOSPIN IMPURITIES. Gignoux, C.; Laverne, A. (Institut des Sciences Nucleaires, Grenoble, France). pp 411–414 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The first-order perturbative treatment of Coulomb energy is known to be unable to account for the experimental ^{3}He–^{3}H energy difference even when reasonably good wave functions are available. Here the results of "exact" calculations are reported for the A = 3 system with T_z-dependent interactions, i.e., Coulomb potential and a charge asymmetric potential (C.A.). The Faddeev equations are solved with these charge-dependent interactions superimposed on the usual nucleon-nucleon interaction. The Reid soft-core potential (R.S.C.) and the Cogny, Pires and de Toureil potential (C.P.T.)—which is suitable for both two-nucleon and spherical nuclei data—are used. To the usual S, S′ and D symmetric Faddeev amplitudes are added a $T = \frac{1}{2}$ S′ symmetric component. In the configuration space the Faddeev equations turn into partial derivative equations. Then the potential and the eigenvalue occur explicitly. The differential set is solved by a simple relaxation method. (auth)

4915 SOME OFF-SHELL EFFECTS IN TRITON CALCULATIONS. Haftel, M. I. (Naval Research Lab., Washington, DC). pp 415–418 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Recent numerical advances of solving the Faddeev equations render the three-nucleon bound-state problem manageable for potentials that act in a small number of partial waves; hence, the triton problem provides an essentially exact theory to study the effects of varying the off-shell two-nucleon interaction. In a previous paper it was shown that exactly phase-shift-equivalent potentials give significant changes (greater than 1 MeV) in the triton binding energy (E_T) only if they predict appreciably different deuteron wave functions. Here the author studies more closely the relation between off-shell changes in the deuteron wave function (ψ_D) and changes in triton binding energy and triton charge form factor ($F_{ch}(q^2)$) predictions. The main result is that an apparently consistent relation exists between the calculated triton properties and the deuteron wave function. (auth)

4916 $\frac{1}{2}^+$ THREE NUCLEON STATES FOR REALISTIC LOCAL POTENTIALS BELOW THE BREAKUP THRESHOLD. Hennell, M. A.; Delves, L. M. (Univ. of Liverpool). pp 419–421 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Preliminary results of variational calculations for the three-nucleon system with the Reid and Gammel–Brueckner (G-B) potentials were recently reported. In this paper an extension of the calculations is made to include the expectation values of physically interesting quantities such as charge form factors, Coulomb energy, etc. The results for these two potentials are compared with those obtained previously for the Hamada–Johnston potential, and with the results of other calculations. (auth)

4917 FORM FACTOR OF ^{3}He WITH THE HAMADA–JOHNSTON POTENTIAL. Hu, C. Y. (California State Univ., Long Beach). pp 422–424 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Charge form factor, Coulomb energy, and root-mean-square charge radius of ^{3}He are calculated with a number of variational wave functions. The wave functions are expanded in terms of polynomials of interparticle distances with proper symmetry. The 170-term wave functions are calculated with the Hamada–Johnston potential. Nonlinear variational parameters in the exponential tails are varied to give the various wave functions. Binding energy for ^{3}H obtained for these wave functions ranges between −4 MeV and −6.1 MeV. Coulomb energy for the ^{3}He varies from 0.64 MeV to 0.71 MeV. r_{rms}^{ch} varies from 1.96 fm to 1.66 fm. (auth)

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Refer also to abstracts 3419, 3423, 4112, 4291, 4538, 4560, 4563, 4844, 4880, 4891, 4996, 5001, 5054–5057, 5082, 5099, 5123, 5138, 5147, 5183, 5185, and 5200.

4918 (CONF-720724-P1, pp 437–447) FRAGMENTATION OF HIGH-ENERGY HEAVY IONS IN CARBON. Wefel, J. P.; Kidd, J. M.; O'Dell, F. W.; Shapiro, M. M.; Silberberg, R. (Naval Research Lab., Washington, DC). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Thin carbon targets were exposed to the high-energy ^{14}N and ^{20}Ne beams at the Princeton Particle Accelerator in order to simulate the breakup of cosmic-ray nuclei by collision with the upper atmosphere. In a nuclear emulsion detector, the mean width of each track was measured with a double-slit photodensitometer,

which provided separation of the fragments from the beam as well as identification of the particle that produced the track. Preliminary information from plates exposed to the ^{20}Ne beam at ~258 MeV/amu is presented, and estimates of partial cross sections for fragmentation are discussed with regard to their application to astrophysical problems. (5 figures, 1 table) (auth)

4919 (CONF-720724-P2, pp 125-131) EXCITATION AND DISINTEGRATION OF RESIDUAL LIGHT NUCLEI IN NUCLEAR EMULSION IRRADIATED BY 1.5 GeV/c K^- MESONS. Waheed, A.; Juric, M. (Inst. of Physics, Belgrade). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A rough estimate of the excitation energy of light nuclei in emulsions is given; identification of black tracks is based on a kinematical analysis. In two cases where accurate measurement of the energy release in both primary and cascade phase was possible, total kinetic energy was checked and found to be conserved. All residual nuclei with A = 8, 9, 10, 11, and 12 were found to have equal amounts of excitation because the excitation mechanism is the same. The following ratio for the interactions on different target nuclei was found: C : N : O = 61.3 : 12.9 : 25.8. (1 figure, 2 tables) (RWR)

4920 (CONF-720724-P2, pp 132-142) DEPENDENCE OF THE MULTIPLICITY OF RELATIVISTIC CHARGED PARTICLES ON THE ATOMIC NUMBER IN THE INTERACTION OF π^- MESONS WITH A MOMENTUM OF 17 GeV/c AND PROTONS WITH MOMENTUM OF 60 AND 67 GeV/c WITH NUCLEI OF A PHOTOEMULSION. Maslennikova, N. V.; Mel'nichuk, T. A.; Tret'yakova, M. I.; Chernyavskii, M. M. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The photoemulsion G5 was irradiated with π^- mesons at 17 GeV/c and the photoemulsions BR-2 and BRx4y were irradiated with protons at 67 and 60 GeV/c respectively. For the nuclear interactions found during scanning along the track, the distribution of the mean free path of slow particles was studied. The criteria for the separation of the interactions on light nuclei (CNO) and heavy nuclei (AgBr) by the presence of particles with a short mean free path were refined. The interactions with $1 \leq Nh \leq 6$ and with $R_{min} \leq 80\ \mu$ in the usual emulsion or with $R_{min} \leq 120\ \mu$ in the dilute emulsion (BRx4y) were assigned to CNO. Events with $R > R_{min}$ were assigned to AgBr. All events with $Nh \geq 7$ were assigned to interactions on AgBr. From a consideration of the size of the interaction cross section on CNO and AgBr, a separation of the events with $n_b = 0$ and $n_g = 0.1$ was made. The mean value of the number of relativistic particles during the interaction of π^- and protons with emulsion nuclei was tabulated. (tr-auth)

4921 (CONF-720724-P2, pp 153-159) SOME CHARACTERISTICS OF Σ HYPERON ABSORPTIONS IN NUCLEAR EMULSION. Drndarevic, S.; Simonovic, J. (Inst. of Physics, Belgrade). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

In a stack of nuclear emulsions exposed to a slow K^- meson beam, absorptions of Σ hyperons were studied. From a sample of more than 100,000 K^- meson stars 363 Σ_o events (with $R_\Sigma \geq 200\ \mu$m) were detected, which number corresponds to the total number of 1194 ± 62 Σ interactions. Analysis showed that the relative proportion of Σ absorptions on heavy (Ag,Br) and light (C,N,O) nuclei is nearly the same. From these Σ_o stars 38 hypernuclei (3.18 ± 0.52)% were detected (16 mesic and 22 nonmesic). It is proved that about 86% of the hypernuclei were produced from Σ captures on light and 14%, on heavy emulsion nuclei. It was also found that the excitation energy of the residual nuclei is higher in Σ_o captures with hypernuclei as compared to those without them. (auth)

4922 (CONF-720724-P2, pp 170-176) INTERACTIONS OF ENERGETIC NEON WITH EMULSION NUCLEI. McNulty, P. J. (Clarkson Coll. of Tech., Postdam, NY); Filz, R. C. 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

A stack of 15 Ilford G-5 emulsion pellicles was exposed to a beam of 280-MeV/nucleon neon nuclei to study the nucleus–nucleus interaction. The distribution of events according to total number of prongs, according to the number of light prongs, the angular distribution for light and gray prongs, and the distribution of track widths for secondary fragments are shown. It was concluded that the dominant mechanism for nucleus–nucleus interactions for incident neon energies as low as 100 MeV/nucleon is the production of charged and/or neutral pions in interactions within the incident nucleus. Nuclear emulsion appears to be suitable for studies on the relationship between pion production and the degree of fragmentation of the incident nucleus. At intermediate energies the measurements of the kinetic energy and emission angles for both the light and gray tracks can be expected to help interpret the fundamental interaction. (5 figures, 1 table) (RWR)

4923 (CONF-720724-P2, pp 177-183) MUON INELASTIC INTERACTIONS STUDIED WITH NUCLEAR PHOTOGRAPHIC EMULSION. McNulty, P. J.; Cruty, M. R.; Shivpuri, R. K. (Clarkson Coll. of Tech., Potsdam, NY). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Preliminary results on the exposure of Ilford G-5 emulsion pellicles to a beam of 5.0-GeV/c μ^+ are presented. Distributions in kinetic energy for black prongs emerging from 1 + 1, 2 + 1, and 3 + 1 events are shown. The three distributions appear similar and extend over the same range of energies, but a significant difference appears among these types of events when the q^2 distributions are compared. The 3 + 1 distribution extends to considerably higher values of q^2. It was concluded that 2 + 1 and 1 + 1 events are the result of essentially nuclear interactions which do not involve pion production. (5 figures) (RWR)

4924 (CONF-720724-P2. pp 194-200) EXPERIMENTS AT THE HIGH-ENERGY HEAVY-ION LBL BEVATRON ACCELERATOR TO STUDY HEAVY ION FRAGMENTATION IN COSMIC RADIATION, PRELIMINARY RESULTS. Kaiser, R. (Univ., Strasbourg); Massue, J. P.; Pfohl, R.; Schmitt, R.; Cueer, P.; Fernandez, F.; Tomas, M.; Medina, J.; Dura, A.; Gandia, V.; Bolta, J. M.; Ramon, J. L.; Senent, F. 1972. (In French).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Preliminary results are reported on the interaction of nitrogen ions at 2.1 GeV/nucleon with emulsion nuclei. The mean free path of the ion tracks was calculated; and the value obtained, compared with mean free path values for heavy ions in cosmic radiation. The nuclear interactions in the emulsions were classified according to the number and nature of the branches. (4 figures, 1 table) (JSR)

4925 (CONF-720724-P2, pp 224-230) STUDY OF THE ELECTRODISINTEGRATION OF CARBON AT 800 MeV USING PLASTIC DETECTORS. Baroni, G.; Di Liberto, S.; Petrera, S.; Romano, G. (Istituto Nazionale di Fisica Nucleare, Rome). 1972. (In French).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The disintegration products resulting from the irradiation of a polystyrene target with 800-MeV electrons were measured with plastic detectors of nitrocellulose (Kodak CA 8015). Preliminary results on the energy and angular distributions of α particles, ^{7}Li, ^{9}Be, ^{11}B, are reported. (4 figures) (JSR)

4926 (JAERI-1228, pp 131-138) ELASTIC AND INELASTIC SCATTERING OF 21.5 MeV NEUTRONS FROM ^{12}C. Yamanouti, Y. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. (In Japanese).

Differential cross sections in an angular region from 30°–155° in the lab system for both elastic and inelastic neutron scattering by carbon have been measured at an incident energy of 21.5 MeV by using the pulsed beam time-of-flight technique. The collective 2^+(Q = −4.43 MeV) level and 3^-(Q = −9.64 MeV) level were resolved by using a newly constructed multi-angle time-of-flight spectrometer. The elastic scattering data were analyzed using the local optical model in its conventional form, and a coupled-channel analysis for the elastic and inelastic scattering has been made. (auth)

4927 (ORNL-TM-4538) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH FLUORINE AND LITHIUM FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.55 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 65p. Dep. NTIS $6.25.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with lithium fluoride were obtained for neutron energies between 0.55 and 20 MeV for θ_γ = 125 deg. The cross-section values were obtained by using a NaI photon spectrometer and the Oak Ridge Electron Linear Accelerator as the neutron source. The data for neutron interactions with fluorine are presented as gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \sim 9$ MeV; for these data neutron energy intervals varied from 0.25 MeV for $1.25 \leq E_\gamma \leq 2$ MeV to 3 MeV for $14 \leq E_n \leq 20$ MeV. The data for neutron interactions with lithium are presented as gamma-

ray production cross-section values of $d\sigma/d\omega$ for the 0.478-MeV gamma ray; for the data the neutron energy intervals varied between 10 keV at threshold and 1 MeV for $E_n \geq 14$ MeV. (auth)

4928 ENERGY CORRELATIONS IN THE REACTION ^{9}Be(d,tα)^{4}He AT 26.3 MeV. Sonnemans, M. A. A.; Waal, J. C.; Van Dantzig, R. (Instituut voor Kernphysisch Onderzoek, Amsterdam, The Netherlands). Phys. Rev. Lett.; 31: No. 22, 1359-1362 (26 Nov 1973).

The three-body reaction ^{9}Be+d $\rightarrow$ t+α+α has been studied in a kinematically complete way at E_d=26.3 MeV. The data are represented in terms of projections for selected parts of the Dalitz plot, emphasizing the two-body resonance structure. Excitation energies and widths for the broad resonances are deduced. Although the reaction mechanism is shown to be predominantly sequential, we have observed a significant three-body breakup contribution (about 19% over the entire three-body phase space). (auth)

4929 DIRECT PROCESSES IN THE ^{6}Li(α,d)^{8}Be REACTION. Lebedev, V. M.; Spasskii, A. V.; Teplov, I. B.; Zelenskaya, N. S. (Moscow State Univ.). Nucl. Phys.; A223: No. 2, 351-364(1974).

The angular distributions of deuterons from the ^{6}Li(α,d)^{8}Be reaction corresponding to the 0^+ ground state and the 2.9 MeV (2^+) state in ^{8}Be were measured at E_α = 17.3, 23.3 and 25.1 MeV. The excitation functions for this reaction were measured at seven emission angles in the region from 12 up to 25 MeV. The experimental angular distributions are compared with theoretical predictions obtained using DWBA stripping calculations and the plane wave approximation (PWA) for various direct processes. It is shown that the experimental angular distributions can be described throughout the angular region using the simple mechanisms associated with the break-up of the ^{6}Li target nucleus, namely, knock-on of nucleon clusters and heavy-particle stripping. The interference of these processes is taken into account. (auth)

4930 MICROSCOPIC AND MACROSCOPIC CALCULATIONS OF THE BREATHING MODE STATE. Sharp, R. W.; Zamick, L. (Rutgers- The State Univ., New Brunswick, NJ). Nucl. Phys.; A223: No. 2, 333-341(1974).

The energy of the breathing mode in nuclei can be calculated both from a macroscopic point of view via the nuclear compressibility and from a microscopic point of view in the TDA and RPA formalisms. Results of both types of calculation for ^{16}O are compared using several self-consistent effective interactions and a couple of more traditional interactions motivated by nuclear structure. A comment is made on the degree of consistency between the results of both types of calculation, some of the technical considerations in carrying out the calculations, and some of the extremes to which the effective interaction can be pushed without changing the breathing mode energy. (auth)

4931 EVIDENCE OF E1 EXCITED STATES IN ^{19}F FROM THE (γ,t) REACTION. Skopik, D. M.; Shin, Y. M. (Univ. of Saskatchewan, Saskatoon). Nucl. Phys.; A223: No. 2, 409-415 (1974).

The ^{19}F(γ,t)^{16}O reaction was studied over an energy region of 18 to 23 MeV. Two resonances were observed at 18.8 and 20.1 MeV. The angular distribution of tritons from these resonances indicated that the tritons are emitted predominantly in a p-wave, implying $J^\pi = 1/2^-$, or $3/2^-$ with $T = 1/2$ for both levels. A comparison with other experiments indicates that the states could be attributed to ^{16}O + t cluster configurations. In addition, from the measured ratio $\sigma(\gamma,\alpha)/\sigma(\gamma,t) \lesssim 0.01$, it is concluded that the formation of ^{15}N + α cluster states is small in this region of excitation. (auth)

4932 CROSS SECTION OF THE PHOTONUCLEAR REACTION FOR ^{9}Be. Antropov, G. P.; Vakhlamov, V. A.; Mitrofanov, I. E.; Russkikh, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2657-2662(Dec 1973). (In Russian).

The cross section of the photonuclear reaction for ^{9}Be from threshold to 15.5 MeV is measured. The energy dependence of the cross section indicates the complex resonance structure. Possible values of the spin and parity of levels of ^{9}Be are discussed. (tr-auth)

4933 STUDY OF THE REACTION ^{13}C(α,d)^{15}N. Lebedev, V. M.; Spasskii, A. V.; Teplov, I. B. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2663-2666(Dec 1973). (In Russian).

The energy and angular dependence of the differential cross section of the ^{13}C(α,d)^{15}N reaction and of the elastic scattering of α particles on ^{13}C is measured in the energy interval E_α = 15 to 25 MeV. The excitation functions are measured at θ_{lab} = 40, 90, and 170° for the ^{13}C(α,d)^{15}N reaction and at θ_{lab} = 90 and 170° for the elastic scattering. The angular distributions of deuterons are obtained at E_α = 18.7, 20.4, and 25.3 MeV. The angular distributions of the elastic scattering of α particles are measured in the rear hemisphere at E_α = 18.3 MeV. (tr-auth)

4934 ON INDUCED DOUBLE-NUCLEON EMISSION. III. ^{12}C(π^-,NN) AND SHORT-RANGE CORRELATIONS. Morris, J.W. Jr.; Weber, H.J. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Ann. Phys. (N.Y.) 79: No. 1, 34-67 (July 1973).

The reaction channel (π^-, NN) for the absorption of bound negative pions by nuclei is used as a means to study nuclear short range correlations. A three-body partial-wave analysis has been carried out for the final-state scattering which includes a Reid soft-core nucleon-nucleon interaction and an optical potential. This coupled-channel formalism rapidly converges as we eliminate the asymptotic single-nucleon and deuteron interactions. It is found that for ^{12}C reasonable agreement with experiment cannot be obtained in this model without modification of the high relative-momentum components of bound shell model pair wave functions. (auth)

4935 THEORETICAL STUDY OF PION QUASI-FREE SCATTERING ON NUCLEI. Liu, L. C. (Univ., Neuchatel, Switzerland). Nucl. Phys.; A223: No. 3, 523-540(1974). (In French).

The experimental results of the reaction ^{12}C(π^+,π^+p)^{11}B at about 130 MeV can be explained satisfactorily by using a modified distorted wave impulse approximation. The strong inelasticity in the elastic channel at these energies makes the knock-out reaction essentially peripheral. It is shown that under these circumstances the knock-out reaction can be used to obtain information about the off-shell pion-nucleon scattering amplitude. Future experiments in this direction are suggested. An invariant half-off-shell pion-nucleon scattering amplitude was introduced and the DWIA method was re-examined in a relativistic way. (auth)

4936 ANALYTIC DESCRIPTION OF INELASTIC ELECTRON SCATTERING ON NUCLEI. Knoll, J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A223: No. 3, 462-476(1974).

An expansion of the DWBA matrix element in terms of Born matrix elements and their derivatives with respect to momentum transfer q is deduced. A high energy approximation of electron waves allows an analytic determination of the expansion coefficients. A quantitative agreement with the exact amplitude is obtained at high momentum transfers. The behavior of inelastic cross sections in the presence of strong Coulomb corrections is studied. Methods which separate charge and current contributions for heavy nuclei, are discussed. (auth)

4937 NUCLEAR POLARIZABILITY CORRECTIONS TO PION ELASTIC SCATTERING. Miller, G. A. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Phys.; A223: No. 3, 477-491(1974).

The corrections to pion elastic scattering given by the process in which the pion excites a collective mode of the target nucleus and then de-excites it leaving the target in the ground state are studied. A perturbative scheme enables one to calculate these corrections easily and without solving coupled-channel equations. Results are presented for pion scattering on ^{12}C, ^{58}Ni and ^{176}Yb. The corrections that are calculated are small except at the diffraction minima where they cause a deepening, and at back angles. (auth)

4938 SIGNIFICANCE OF THE THREE-BODY BREAK-UP MECHANISM FOUND IN THE STUDY OF THE ^{7}Li(p,2d)^{4}He REACTION. Furic, M.; Cole, R. K.; Forster, H. H.; Kim, C. C.; Park, D. Y.; Rucker, J.; Spitzer, H.; Waddell, C. N. pp 711-714 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Recently evidence of a new three-body break-up mechanism involving a nuclear reaction performed on a cluster of nucleons within a nucleus, was found. Further experimental data on the ^{7}Li(p,2d)^{4}He reaction in both symmetric and nonsymmetric geometries were accumulated. Nonsymmetric geometry measurements were made in order to examine whether the positions of the experimental broad structures follow the predictions based on the model of a quasi-free interaction between the incident particle and the triton cluster. An improved PWIA was calculated by inclusion of the experimental cross section for the p + t $\rightarrow$ 2d reaction. A possible way to study few particle correlation inside the nucleus by comparing this mechanism with quasi-free scattering is discussed. (auth)

4939 ENERGY DEPENDENCE OF p-n PROXIMITY SCATTERING. Cameron, J. M.; Neilson, G. C.; Sharma, T. C. pp 707-710 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction, Los Angeles, CA (28 Aug 1972).

As the predictions of proximity scattering are a necessary con-

sequence of existing theories of final state interactions it is desirable to have an unambiguous verification of the effect. Measurements on the $^{12}C(d,pn)^{12}C$ reaction in the energy range 5.15 to 6.5 MeV are reported which strengthen the claim of observation of rescattering in this reaction. (auth)

4940 PROXIMITY SCATTERING REALLY EXISTS. Gemmeke, H.; Baumgartner, D.; Richter, A.; Lassen, L. pp 715-719 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

In order to observe rescattering and to estimate the magnitude of interfering effects excitation functions of the reactions $^{12}C(d,np)$ and $^{40}Ca(d,np)$ were measured for bombarding energies E_d = 5.2 to 9.8 MeV, since proximity scattering is kinematically restricted to a limited range of E_d. In addition azimuthal angular distributions were taken at 5.5 MeV bombarding energy. It is concluded that a possible admixture of the singlet n-p final-state interaction to proximity scattering must be less than 15% in the two reactions. (auth)

4941 COMPARISON OF p,2p AND p,pn KNOCKOUT FROM ^{6}Li. Miller, C. A.; Bonbright, D. I.; Watson, J. W.; Wilson, F. J. pp 731-734 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A comparison of p,2p and p,pn knockout on ^{6}Li at 46 MeV is reported. Experimental results and comments upon the striking features observed are given. The most striking feature of the data for both reactions is the absence of a deep minimum in the cross section as would be expected for p-shell knockout. A comparison of spectra taken at equal angles shows that the p-state minimum is still obtained at large scattering angles. (auth)

4942 CONSTRAINED HARTREE–FOCK CALCULATION FOR THE REACTION $^{16}O + {}^{16}O \leftrightarrow {}^{32}S$. Flocard, H. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 49B: No. 2, 129-132(1 Apr 1974).

A constrained Hartree–Fock calculation for the process $^{16}O + {}^{16}O \leftrightarrow {}^{32}S$ has been performed using the Skyrme interaction. The Hartree–Fock equations have been solved on a basis of orthogonal polynomials defined by an appropriate two-center weight function. This choice is much more convenient in numerical applications than a two-center harmonic oscillator basis. The height and location of the barrier in the deformation energy curve compare well with the corresponding values of phenomenological potentials. (auth)

4943 MULTIPARTICLE BREAKUP REACTIONS ON SOME LIGHT NUCLEI INDUCED BY 14.4-MeV NEUTRONS. Antolkovic, B. pp 695-698 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The 14.4-MeV neutron-induced multiparticle breakup reactions on ^{7}Li and ^{12}C were investigated. The complete determination of the reaction kinematics was achieved by detecting simultaneously all of the charged particle products of the reaction using the nuclear emulsion technique. The purpose of this study was to obtain spectroscopic information on the nuclear unstable states involved and to examine the validity of the sequential reaction mechanism of the respective reaction processes. In particular, the interest was concentrated on the $n + {}^{12}C \rightarrow n + 3\alpha$ reaction in order to provide data on the ^{12}C level structure which is less known in the energy region between 7.28 and 15.96 MeV (the thresholds for dissociation of ^{12}C into 3 α's and into $p + {}^{11}B$, respectively. (auth)

4944 ODD-PARITY LEVELS EXCITED IN ^{32}S AND ^{36}Ar VIA ALPHA-PARTICLE TRANSFER. Lindgren, R. A.; Trentelman, J. P.; Anantaraman, N., Gove, H. E.; Jundt, F. C. (Univ. of Rochester, NY). Phys. Lett.; 49B: No. 3, 263-265(15 Apr 1974).

At excitation energies above 4 MeV, several negative parity levels in ^{33}S and ^{36}Ar are found to be excited strongly in the (^{6}Li,d) "α-particle" transfer reaction. These transitions have cross sections comparable in magnitude to those in which all four nucleons are transferred into a single major shell. (auth)

4945 ISOSPIN SPLITTING OF THE ^{13}C GIANT DIPOLE RESONANCE IN THE CONTINUUM SHELL MODEL. Marangoni, M.; Ottaviani, P. L.; Saruis, A. M. (CNEN, Bologna). Phys. Lett.; 49B: No. 3, 253-257(15 Apr 1974).

An investigation on the isospin components of the ^{13}C giant dipole resonance was carried out by means of the 1p and 2p-1h shell model including the one-particle continuum. The continuum photoreaction cross sections and angular distributions were compared with experiment. The T and T + 1 dipole strengths with their related sum rules were inferred from a discrete calculation based on the same assumptions as the continuum model. (auth)

4946 MOLECULAR ORBITALS AND MULTIPLE TRANSFER IN THE ELASTIC COLLISION OF ^{16}O ON ^{17}O. Bohlen, H. G. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Noerenberg, W. Phys. Lett.; 49B: No. 3, 227-230(15 Apr 1974).

A description of the elastic scattering of ^{16}O on ^{17}O is presented using molecular orbitals for the valence neutron. Effects from the multiple transfer of the valence particle turn out to be significant for shallow potentials with realistic absorption. (auth)

4947 DEFORMED HARTREE–FOCK CALCULATIONS NOT RESTRICTED TO VERY SHORT RANGE EFFECTIVE INTERACTIONS. Titin-Schnaider, C. (D–Ph–N–MF, Saclay, France); Quentin, P. Phys. Lett.; 49B: No. 3, 213-216(15 Apr 1974).

Some results of deformed Hartree–Fock calculations for s-d shell nuclei are presented. A phenomenological effective interaction due to Gogny has been used which consists of two Gaussians plus a delta interaction depending on the density as ρ^{α}. The trend of deformation properties in this region is rather well reproduced. (auth)

4948 STRUCTURE OF ^{10}B FORMED BY THE REACTION $^{9}Be + p$. Yasue, M.; Ohsawa, T.; Fujiwara, N.; Kakigi, S.; Nguyen, D. C.; Yamashita, S. pp 1009-1011 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The levels of ^{10}B near 10 MeV excitation were studied through the reaction $^{9}Be + p$ in the energy range of protons from 4 to 6 MeV. Resonance peaks corresponding to the 10.8 and 11.2 MeV state of ^{10}B were observed in the $^{9}Be(p,p_0)$ $^{9}Be(2.43$ MeV) channel at E_p = 4.7 MeV and in the $^{9}Be(p,p_1)$ $^{9}Be(1.67$ MeV) channel at E_p = 5.1 MeV, respectively. The effect of final s state interactions between n and ^{8}Be(g'nd) in the $^{9}Be(p,p_1)$ $^{9}Be(1.67$ MeV) reaction are mentioned. (NL)

4949 J-DEPENDENCE IN KNOCK-OUT REACTIONS. Jackson, D. F. pp 976-978 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Experimental studies have shown that a wide variety of transfer reactions exhibit J-dependence. This means that for a given angular momentum transfer L the angular distributions show distinctly different behavior for the different values of the total angular momentum J. There is no clear evidence for any J-dependent effects in knock-out reactions. There was some speculation about the 460 MeV data for $P_{\frac{1}{2}}$ and $P_{\frac{3}{2}}$ knock-out in the $^{16}O(p,2p)$ reaction. However, it can be shown that such an experiment using coplanar symmetric geometry is the least likely to reveal any J-dependence. A more advantageous experimental geometry for the study of J-dependence is one in which one particle comes out near the forward direction while the other emerges at a much larger angle and lower energy. The matrix element for this process was derived. (auth)

4950 SUPERMULTIPLET EXPANSION AND OSCILLATOR CLUSTER PARENTAGE OF LIGHT NUCLEI. Kramer, P.; Schenzle, D. pp 983-986 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Translational-invariant oscillator cluster parent states containing k sets $a = a_1 \ldots a_k$ of internally unexcited oscillator clusters while the state of the relative motion $\hat{x}^s$, $s = 1 \ldots k-1$ carries N_s quanta of excitation are defined. The energy levels of ^{6}Li are studied as an example. The states are described in terms of two-cluster parents a = 42,33 with oscillator excitation $N \leq 6$ adapted to the orbital partition $f = \{42\}$. The general features of a k-cluster configuration are discussed. (NL)

4951 α DECAY OF LIGHT NUCLEI. Kadmenskii, S. G.; Martynov, A. A.; Kharitonov, Yu. I. (Voronezh State Univ. USSR). Yadern. Fiz.; 19: No. 3, 529-538(Mar 1974). (In Russian).

A variant of the theory of α decay (not of the R-matrix type), used earlier to study the α decay of heavy nuclei, is developed to study the α decay of light nuclei. Integral formulas for the α widths in the shell model and in the cluster model are constructed. It is shown that the calculations of α widths in the cluster model for states of light nuclei having large spectroscopic factors of α-particle separation provide with results close to those of the shell model. It is found that the α widths of a number of levels in nuclei ^{6}Li, ^{7}Li, ^{7}Be, ^{8}Be, ^{12}C, calculated on basis of the shell model, are in a reasonable agreement with the experimental data. Additional conditions are noted that are necessary for the R-matrix scheme to be used to calculate the α widths. (auth)

4952 α-CLUSTER LEVELS IN ^{16}O AND ^{20}Ne AND THE SURFACE POTENTIAL WELL MODEL. Gol'dberg, V. Z.; Rudakov, V. P.; Timofeev, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 3, 503-515(Mar 1974). (In Russian).

The α-cluster levels in ^{16}O and ^{20}Ne nuclei are classified in framework of the surface potential well model. Quantum numbers of the states (spin, parity), excitation energies and the spectroscopic factors (reduced widths) are taken into account in the analysis. The result of the detailed consideration is that much more than a half of about 40 known states of ^{16}O up to the excitation energies ~16 MeV may be classified as α-cluster levels. Properties of some highly excited states are predicted on basis of the fulfilled systematization. (auth)

4953 POSSIBLE INTERPRETATION OF HIGH ENERGY PEAKS IN NEUTRON: ^{12}C COLLISION CROSS SECTIONS. Ol'khovskii, V. S.; Strizhak, V. I.; Totskii, Yu. I.; Tustanovskii, V. T.; Chinarov, V. A. (Kiev State Univ.). Yadern. Fiz.; 19: No. 3, 580-582(Mar 1974). (In Russian).

Based on the modified theory of many-particle resonances in framework of the shell model an identification is proposed for the experimental peaks in the (n,p) reaction cross section of the ^{12}C nucleus as intermediate decaying states of the compound nucleus. (auth)

4954 α-D STRUCTURE OF ^{6}Li NUCLEUS BY MEANS OF THE REACTION ^{6}Li(e,e'p)^{5}He AT HIGH ENERGIES. Barts, B. I.; Bolotin, Yu. L. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 3, 570-579(Mar 1974). (In Russian).

The reaction ^{6}Li(e,e'p)^{5}He is investigated with account of instability of the final nucleus ^{5}He. An effective function is introduced in the cluster model that enables one to simplify analysis of the obtained results. The distorted momentum distributions are obtained. It is shown that the α-d model of ^{6}Li nucleus describes the reaction ^{6}Li(e,e'p)^{5}He reasonably without any additional fitting parameters. (auth)

4955 MEASUREMENT OF THE TOTAL CROSS SECTIONS OF π^- PHOTOPRODUCTION ON CARBON. Epaneshnikov, V. D.; Kuznetsov, V. M.; Stukov, O. I. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz.; 19: No. 3, 483-485(Mar 1974). (In Russian).

The activation analysis is used to measure the yields from the reaction ^{12}C(γ,π^-)^{12}N from the threshold of the π^--meson production to 375 MeV. The total cross sections are as well calculated. The results are satisfactory fitted by the model of surface meson production. (auth)

4956 INELASTIC SCATTERING OF ELECTRONS ON NUCLEI Be, Cu, Ag AT 1.2 GeV. Titov, Yu. I.; Stepula, E. V.; Afanas'ev, N. G.; Akhmerov, R. V.; Severin, N. F. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 3, 479-482(Mar 1974). (In Russian).

The cross sections of inelastic scattering of electrons by nuclei Be, Cu, Ag are measured at 1.2 GeV and 20, 25, 30, and 35° scattering angles. The measurements were carried out in the region of the quasielastic scattering and the isobar Δ_{1236} electroexcitation. Comparison with the impulse approximation shows that it is necessary to take into account the final state interaction. (auth)

4957 THREE α-PARTICLE SYSTEM IN ^{12}C EXCITED STATES. Jacquot, C.; Sakamoto, Y. pp 979-982 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The three α-particle states led by inelastic scattering of 90 MeV α-particles on ^{12}C are considered. The excitation energy spectrum of ^{12}C made up by the α-particles is shown. It is thought that some states in ^{12}C are caused by the final-state interaction of the α particles and hence these states can be studied by plotting the energies of the three α particles in a Dalitz diagram. Dalitz plots are shown for excitation energies of 20.9 and 32.5 MeV. (auth)

4958 MEASUREMENTS OF THE POLARIZATION AND DWIA-CALCULATIONS FOR THE INELASTIC SCATTERING OF 185 MeV PROTONS FROM ^{12}C. Ingemarsson, A. (Uppsala Univ.). Phys. Scr.; 9: No. 2, 73-78(Feb 1974).

The polarization of 185-MeV protons scattered inelastically from ^{12}C was measured for the 9.6 and for the 15.1 MeV level. Calculations in the distorted-wave impulse approximation (DWIA) give results which show good agreement for the 9.6 MeV level but disagreement for the 15.1 MeV level. The Coulomb interaction between two protons is included in the nucleon–nucleon matrix, and the effect of this is investigated, also for the 7.7 MeV level. (auth)

4959 ABSORPTION OF S-WAVE PIONS BY ^{6}Li. Mett, N. P. (Open Univ., Walton Hill, Eng.); Jackson, D. F. pp 898-901 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The absorption of low energy pions on nuclei leading to two-nucleon emission is well established as a means of investigating nuclear structure. A formalism was developed for absorption of low energy ($0 < T_\pi < 100$ MeV) pions and some preliminary calculations were made for the ^{6}Li(π^+,2p) reaction, for which there exists some experimental information. (auth)

4960 ENERGY CALCULATIONS FOR ^{6}Li WITH SHORT-RANGE DYNAMICAL CORRELATIONS. Lodhi, M. A. K.; Clingan, M. N. pp 987-990 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The Jastrow type wave function was invoked to study how the parameters used in fitting the experimental form factor of ^{6}Li account for the energy. It is seen that the Jastrow type correlated wave function which fits the electron scattering data seems to give rather unrealistic results for the energy of ^{6}Li. (NL)

4961 THREE BODY BREAK-UP OF ^{12}C BY 52 MeV PROTONS. Yamashita, S. (Nara Women's Univ., Japan); Fukunaga, K.; Kakigi, S. pp 1006-1008 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Many of the excited states of ^{12}C are reported to decay into three alpha particles. The three body break-up reaction of ^{12}C was studied by bombarding a self-supporting carbon target of 1.5 mg/cm^2 thick with 52-MeV protons, which were extracted from the INS (University of Tokyo) synchrocyclotron. Summed energy spectrum obtained from a two-dimensional energy spectrum of a proton and alpha particle emitted in coincidence is shown. The summed energy spectrum shows that the reaction leaving ^{8}Be in the first excited state prevails and the one leaving ^{8}Be in its ground state occurs seldom. The projection to the proton channel of the whole two-dimensional energy spectrum and of the locus corresponding to the ground and first excited state of ^{8}Be are shown. Both spectra show some peaks corresponding to the excited state of ^{12}C. It is thought that the 21.6 MeV state of ^{12}C has characteristics quite different from the other alpha decaying states. (NL)

4962 MIXING RATIO OF THE $p^{-1}(3/2) \rightarrow p^{-1}(1/2)$ TRANSITION IN ^{15}O. Kean, D. C.; Wormald, M. R. (Univ. of Guelph, Ont.). Can. J. Phys.; 52: No. 3, 265-271(1 Feb 1974).

The mixing ratio of the $3/2^- \rightarrow 1/2^-$, 6.18 $\rightarrow$ 0 MeV transition in ^{15}O was measured using the ^{14}N(p,$\gamma\gamma$)^{15}O reaction. The value obtained is -0.141 ± 0.016, confirming previous indications that this mixing ratio is a factor of two larger than is predicted by shell-model calculations which give values consistent with experiment for the corresponding transition in ^{15}N. The discrepancy may be due to uncertainties in the contributions to the E2 strength from the ^{16}O core and to the effect of different thresholds for nucleon emission in the two nuclei. The analysis of the present experiment necessitated a reevaluation of available data regarding M2 strengths in the lp shell. (auth)

4963 SUM RULE PHOTODISINTEGRATION CROSS SECTIONS OF ^{6}Li. Yadav, H. L.; Srivastava, B. K. (Indian Inst. of

Tech., Kharagpur). Can. J. Phys.; 52: No. 3, 202-206(1 Feb 1974).

The sum rules of Levinger and Bethe were applied to calculate the integrated ($\sigma_{int} = \int_0^\infty \sigma(W)\,dW$) and bremsstrahlung-weighted ($\sigma_b = \int_0^\infty (\sigma/W)\,dW$) cross sections for ^{6}Li using the Gaussian and Irving forms of radial wave functions whose parameters are determined by fitting the rms radius of charge distribution in ^{6}Li. For the potential in the σ_{int} calculation the central velocity-dependent potential of Herndon et al. was used. Results for σ_{int} and σ_b for ^{6}Li show reasonably good agreement with experiments. (auth)

4964 NUCLEAR REACTIONS AND STRUCTURE PROBLEMS IN THE 7- AND 8-NUCLEON SYSTEMS. Clement, D.; Federsel, H.; Hub, R.; Kramer, P.; Teufel, G.; Wildermuth, K. pp 953-956 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Nuclear reactions involving composite particles in both the entrance and exit channels are studied in a unified theory in order to investigate nuclear states in ^{8}Be, ^{7}Li (resp. ^{7}Be) and the mechanisms of the reaction ^{6}Li(p,^{3}He)^{4}He. (auth)

4965 LOW-LYING 0^+ STATES OF ^{16}O IN THE α-PARTICLE MODEL OF LIGHT NUCLEI. Avishai, Y. pp 940-943 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The extent to which the A = 4n, N = Z nucleus can be described as an entity composed of nα particles has recently become a question of considerable interest. Since the excitation energy of the α particle is large compared to the excitation energy of ^{16}O, say, it stands to reason that a four-α-particle model of ^{16}O is reasonable at low energies. In the simplest case, it is assumed that the α particles are rigid, structureless entities. The success of the 3-body theory of Faddeev, Lovelace, and Amado et al. provided the means by which the three-α model of ^{12}C can be investigated. Calculations are carried out of the 0^+ ground state and first excited state of ^{16}O. The exact 4-body theory turns out to be practical if one uses the pole approximation. (auth)

4966 ELASTIC SCATTERING. pp 330-372 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Forty-three papers on this topic are presented. Most of the papers in this section are concerned with heavy-ion scattering; however, elastic scattering of nucleons by deuterium, for instance, is also examined. The optical model was investigated both experimentally and theoretically. The generator-coordinate method, the resonating-group method, the coupled-channel N/D approach, and the Austern-Sasakawa theory of reactions are discussed. Generally applicable theoretical papers are included, as well as papers pertaining to specific nuclides. (RWR)

4967 TRANSFER REACTIONS: EXPERIMENTAL TECHNIQUES. pp 410-412 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Three papers on this topic are presented. They deal with a new method for spin determinations through use of heavy ions, study of direct reactions by analysis of fully measured particle-particle correlation patterns, and (^{16}O,np) and (^{16}O,nα) reactions on some light nuclei. (RWR)

4968 TRANSFER REACTIONS: HEAVY IONS TRANSFER. pp 459-483 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Twenty-five papers on this topic are presented. For the most part, the projectiles were ^{6}Li or heavier, ranging up to ^{19}F. Light and intermediate-mass targets were investigated. The majority of the papers dealt with reaction kinetics, but properties of compound and residual nuclei were also studied. (RWR)

4969 MULTINUCLEON TRANSFER REACTIONS. Scott, D. K. pp 215-253 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

The development of higher energies and better resolution in heavy-ion beams has led to a resurgence of interest in transfer reactions at energies well above the Coulomb barrier. Direct reactions with heavy ions are discussed in some detail. Heavy-ion reactions open up the possibility of new methods of spectroscopy, e.g., elastic transfer. Differential cross sections for heavy-ion transfer reactions are often featureless; however, some data show diffractive effects. The high angular momenta associated with recoil effects in heavy-ion reactions can be exploited to perform selective spectroscopy on light nuclei. Although most heavy-ion-transfer data suggest that reactions proceed in a direct fashion, recent experiments indicate the presence of second-order multistep processes. Correlated nucleon transfer and transfer of many nucleons (e.g., (^{12}C,α)) are also being investigated. (20 figures, 3 tables, 93 references) (RWR)

4970 ELASTIC AND INELASTIC SCATTERING. Pelte, D. pp 255-278 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The investigation of interference phenomena between the Coulomb and the nuclear interaction and possible evidence for the formation of nuclear molecules in heavy-ion collisions are reviewed. Effects arising from nuclear-Coulomb interference are expected to become more pronounced in inelastic scattering, where the electric and real nuclear form factors can be of equal magnitude. Their different signs cause a destructive interference in single-step processes. The depth of the interference minimum in the differential cross section depends strongly on the imaginary part of the nuclear form factor and should allow one to determine this quantity quite accurately. There are heavy-ion systems which display resonance phenomena at energies below and above the Coulomb barrier, phenomena of nonstatistical origin. Evidence for their occurrence are strong angular correlations in the excitation functions and correlated structures in several outgoing channels. Data on a number of heavy-ion reactions are examined. There is as yet no theory that describes all the properties of the sub-Coulomb resonances. Large ^{12}C widths and long lifetimes observed in the ^{12}C + ^{12}C system suggested the interpretation in terms of molecular states. It is concluded that experimental evidence has accumulated which suggests the existence of molecular resonances in a few heavy-ion systems at energies below and above the Coulomb barrier; however, the connection between the sub-Coulomb resonances and those structures observed above the Coulomb barrier is not understood. The different properties of these phenomena, the low spin values and small total widths for resonances below the Coulomb barrier but high spin values and large total widths for those above the Coulomb barrier suggest that they are of a different nature. (13 figures, 2 tables) (RWR)

4971 LIGHT NUCLEI WITH LARGE NEUTRON EXCESS. Volkov, V. V. pp 279-304 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

A history of research on light, neutron-rich nuclei is given first. Then the methods of producing, identifying, and studying extremely neutron-rich light nuclei are considered. Finally, experiments aimed at the estimation of the nucleon stability, mass measurement, and investigation of some other properties of extremely neutron-rich nuclei are discussed. (11 figures, 6 tables) (RWR)

4972 NUCLEAR REACTIONS WITH HIGH-ENERGY PROTONS. Thirion, J. pp 781-796 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

Results at Saclay on high-energy proton reactions are briefly recounted. Spectra and angular distributions and their interpretations for elastic and inelastic scattering of 1-GeV protons by ^{12}C, ^{16}O, ^{6}Li, ^{58}Ni, and ^{208}Pb are given. A preliminary spectrum and angular distribution from ^{12}C(p,d)^{11}C are shown. Experimental facilities are briefly described, and future developments along the lines of polarized beams and synchrotron improvement are mentioned. (13 figures) (RWR)

4973 BOUND STATE OF THREE-ALPHA SYSTEM. Kawazoe, Y. (Tohoku Univ., Sendai); Tsukamoto, T.; Matsuzaki, H.

pp 425-428 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A number of authors have treated the alpha-particle model of ^{12}C. The calculated values of binding energy are quite different from each other, ranging from 13 MeV to 3 MeV due to the different choices of interaction. In this work, the following points were taken into account: i) A separable potential was chosen which reproduces the phase shifts caused by the nuclear part of the alpha–alpha interaction. ii) The nuclear part of the alpha–alpha interaction gives a bound state at −1.4 MeV for S-wave. The potential is chosen to yield this bound state. iii) D and G waves are included: The inclusion of S, D, and G waves is suggested by the L–S coupling shell model of ^{8}Be. iv) In the neighborhood of the origin, the bound state wave function of the alpha–alpha system behaves as the 4-th and higher powers of r. For comparison, the calculation was also performed using the Yamaguchi type potential for the S-wave interaction. It is concluded that any alpha–alpha potential which fits alpha–alpha experimental phase shifts does not yield the energy of ^{12}C. (INIS)

4974 DIFFERENCES IN THE THREE-BODY FINAL STATES OF $^{10}B(d,\alpha)\alpha\alpha$ AND $^{9}Be(^{3}H,\alpha)\alpha\alpha$ AT LOW ENERGIES. Roy, R.; Birchall, J.; Frois, B.; Lamontagne, C. R.; Slobodrian, R. J. pp 998-1001 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Single α-particle angular distributions were measured for the $^{10}B(d,\alpha)^{8}Be$ reaction at 3.5, 4.0, and 5.0 MeV bombarding energies and at six different energies from 3.0 to 10.0 MeV for the ^{9}Be $(^{3}He,\alpha)^{8}Be$ reaction. In the light of the experimental results and the analysis the main difference between the α spectra reached through the ^{10}B + d and ^{9}Be + ^{3}He channels, is reducible to a change in relative populations of the two-body states that can be reached. Dominant two-body interactions reproduce well the present three-body final-state spectra obtained from the two different entrance channels. (NL)

4975 RADIATIVE PION CAPTURE IN ^{12}C AND ^{16}O. Ohtsubo, H.; Nishiyama, T.; Kawaguchi, M. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A; A224: No. 1, 164-185(1974).

Radiative pion capture in ^{12}C and ^{16}O is investigated. An effective interaction Hamiltonian based upon the CGLN theory is employed. Capture rates in ^{12}C and ^{16}O from 1s and 2p pionic orbits are calculated by using the nuclear model of Kamimura, Ikeda and Arima for the odd parity states of ^{12}C, and that of Walker with strong ground state correlations, for the odd parity states of ^{16}O. The results are compared with those of the 1p-1h nuclear model under the Tamm–Dancoff and random phase approximation of Gillet and Vinh Mau. Detailed examinations are made for the transitions to low-lying states with 1^+ and 2^+ for ^{12}C and with 1^-, 2^-, and 3^- for ^{16}O by using the Cohen–Kurath and the Walker models, respectively. The results are in good agreement with the recent experimental data from Berkeley. (auth)

4976 TWO-PARTICLE RPA FOR OXYGEN AND CALCIUM. Bouyssy, A.; Vinh Mau, N. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A224: No. 2, 331-348(1974).

The energies and wave functions of the lowest levels of nuclei with two particles or two holes outside the ^{16}O and ^{40}Ca cores were calculated in the two-particle RPA model taking into account the 2p-2h core correlations. The Tabakin interaction was used and the two-body matrix elements were calculated to first and second order including core polarization diagrams. The 4p-2h correlations included in the model push down the energies of the lowest states. The two-particle transfer form factors were calculated with the RPA model wave functions. (auth)

4977 POSITIVE PION PRODUCTION BY 185 MeV PROTONS. Miller, G. A. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Phys.; A224: No. 2, 269-300(1974).

The $^{12}C(p,\pi^+)^{13}C$ and $^{9}Be(p,\pi^+)^{10}Be$ reactions at 185 MeV are examined. One starts with a model in which the pion is produced by an incident proton which then becomes a bound neutron. A nonrelativistic reduction of the pseudoscalar operator results in a non-Galilean invariant pion production operator. The recent Uppsala data are then fit with a DWBA calculation which takes the pion's distortion from the Kisslinger potential. In this calculation, which uses the free pion-nucleon coupling constant at the interaction vertex, the same pion optical potential accounts for both the elastic and (p,π^+) data. The reaction is sensitive to details of nuclear structure because of the large momentum transfer involved. The final nuclear state has components which consist of a single particle of high angular momentum (or high radial quantum number) coupled to an excited state of the target. The amplitudes of these components are calculated in perturbation theory. Such configurations participate in the reaction in three ways: a (p,p') reaction, in which the target is excited, followed by pion emission from the p'; pion emission from the proton followed by a (π,π') reaction; and, the proton emitting the pion first, and then exciting the target (pre-emission). The size of these effects is not negligible but can be absorbed into the freedom of choosing the wave function of the bound neutron. (auth)

4978 ANGULAR DISTRIBUTIONS IN THE REACTION $^{6}Li(p,^{3}He)^{4}He$. Johnston, G. P.; Sargood, D. G. (Univ. of Melbourne). Nucl. Phys.; A224: No. 2, 349-357(1974).

Angular distributions in the reaction $^{6}Li(p,^{3}He)^{4}He$ were measured over the energy range 0.5 to 0.82 MeV. Two particle pick-up theory is used to analyze the results and, with a constant normalization factor of 0.3, it accounts well for the observations below 1.3 MeV and for the nonresonant yield above 1.3 MeV. (auth)

4979 WAVE FUNCTIONS AND REFLECTION COEFFICIENTS DEDUCED FROM THE OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF 20.1 MeV ALPHA PARTICLES BY ^{16}O. Casal, E.; Garcia, A.; Senent, F. (Univ., Valencia, Spain). An. Fis.; 68: No. 10-12, 305-314(1972).

The origin of specific discrete ambiguities in the optical model analysis of the elastic scattering of 20.1-MeV alpha particles by oxygen-16 is investigated. (JFP)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 2502, 4541, 4892, 4951, 4952, 4966, 4968, 5001, 5016, 5021, 5033, 5049, 5054, 5059, 5081, 5117, 5134, 5136, 5183, 5186, and 5189.

4980 (RCN-210) INVESTIGATION OF THERMAL-NEUTRON CAPTURE IN SOME SD SHELL NUCLEI. Spits, A. M. J. (Stichting Reactor Centrum Nederland, Petten). May 1974. 77p. Dep. NTIS (US Sales Only) $7.00.

Thesis.

A study is made of thermal-neutron capture in the nuclei ^{28}Si, ^{29}Si and ^{37}Cl. The experimental part of the work was performed at the High Flux Reactor at Petten. The excitation of ^{29}Si, ^{30}Si and ^{38}Cl states, populated in the (n,γ) reaction, were determined with 0.09 to 1.2 keV errors, together with the γ-ray branching ratios. A total of 15 Q-values of various (n,γ) reactions is reported too. It is shown that a close parallelism exists between the ^{37}Cl (n,γ) and ^{37}Cl (d,p) reactions such that the relation between (d,p) reduced widths and (n,γ) reduced primary intensities is to a high degree a linear one, if one reduces the latter with a factor $E_\gamma^{-1.2}$ instead of the usual one, E_γ^{-3}. A similar observation was made for other light nuclei. The ^{31}Cl (n,γ) reaction was found to proceed mainly by potential capture. The ^{29}Si (n,γ) reaction was investigated with nonpolarized as well as polarized thermal neutrons. The thermal-neutron capture cross sections of ^{28}Si and ^{29}Si are 160 ± 18 mb and 101 ± 14 mb, respectively. The spin of the E_x = 8.16 MeV state was determined as 1. Especially relating to ^{30}Si states with excitation energy above 6 MeV new information was brought forward. From the experimentally determined spin interference, for a few of these states the ratio of the $2p_{\frac{1}{2}}$ and $2p_{\frac{3}{2}}$ strengths was determined, and compared to the predictions offered by the shell model. (auth)

4981 STRONGLY OSCILLATING ANGULAR DISTRIBUTIONS IN THE REACTION $^{32}S(^{16}O,\ ^{12}C)^{36}Ar$ AT $E_{c.m.}$ = 30 MeV. Braun-Munzinger, P.; Bohne, W.; Gelbke, C.K.; Grochulski, W.; Harney, H.L.; Oeschler, H. (Max-Planck-Institut für Kernphysik, Heidelberg, Germany). Phys. Rev. Lett. 31: No. 23, 1423-1425 (3 Dec 1973).

The elastic scattering of ^{16}O on ^{32}S and the reaction $^{32}S(^{16}O,\ ^{12}C)^{36}Ar$ have been measured at $E_{c.m.}$ = 30 MeV. The elastic-scattering angular distribution exhibits a smooth Fresnel-type diffraction pattern, whereas for the (^{16}O, ^{12}C) reaction we observe strong oscillations in the ground-state transition. (auth)

4982 ANALYSIS OF THE ANGULAR AND ENERGY DEPENDENCES OF THE POLARIZATION OF PARTICLES WITH SPIN ½. Pucherov, N. N.; Romanovskii, S. V.; Chesnokova, T. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2638-2640(Dec 1973). (In Russian).

The results obtained by the use of Spencer's formula for the calculation of the energy and angular dependence distribution of the polarization of particles with spin ½ are compared with experimental results obtained in the measurement of angular distribution of protons at energy from 5 to 50 MeV scattered on targets with mass number from 27 to 209. The importance of the parameter φ in the calculations at comparatively low energies and at energies above 20 MeV is shown by the comparison. (JSR)

4983 NEW BRANCHING IN β^- DECAY OF ^{37}S. Libert, J. (Univ., Mons, Belg.); Klotz, G.; Baumann, P.; Walter, G. Nucl. Phys.; A223: No. 3, 620-626(1974). (In French).

Gamma rays following β^- decay of ^{37}S were investigated with Ge(Li) detectors. Two electromagnetic transitions, previously unreported in ^{37}S decay studies, were identified as originating in ^{37}Cl de-excitation. Their observation yields evidence for a weak allowed β^- branch to the $J^\pi = 3/2^-$, 4.01 MeV level of ^{37}Cl. These new data, in conjunction with former results confirmed in these experiments, determine $J^\pi = 1/2^-$ for the ^{37}S ground state. (auth)

4984 COMPARISON OF NEUTRON RESONANCE SPACINGS WITH MICROSCOPIC THEORY FOR SPHERICAL NUCLEI. Huizenga, J. R.; Behkami, A. N.; Sventek, J. S.; Atcher, R. W. (Univ. of Rochester, NY). Nucl. Phys.; A223: No. 3, 577-588(1974).

The nuclear level spacings determined from neutron resonance experiments for nuclei with $20 \leq A \leq 148$ and $181 \leq A \leq 209$ are compared with spacings calculated for spherical nuclei with a microscopic theory which includes the nuclear pairing interaction. Single particle levels of Seeger et al. and Nilsson et al. are used in the calculations. The gross features of the experimental data due to nuclear shells are reproduced with the microscopic theory. In addition, the absolute agreement between experiment and theory is reasonable (67% of the 151 cases examined agree to within a factor of 2) in view of uncertainties in the experimental data, the theoretical single particle levels and the pairing strength. Values of the spin cutoff parameter $\sigma^2(E)$, calculated with a microscopic theory, are included also for several doubly even nuclei and discussed in terms of nuclear shells. (auth)

4985 ROTATIONAL BAND SHIFTS IN ^{25}Mg AND ^{26}Al. Cole, B. J.; Watt, A.; Whitehead, R. R. (Univ. of Glasgow). Phys. Lett.; 49B: No. 2, 133-136(1 Apr 1974).

Shell-model calculations were performed for ^{26}Al and ^{25}Mg in order to examine suggested remedies for the band shifts reported earlier. The ^{26}Al calculation shows that augmentation of the ALS component of the effective interaction does not work for this nucleus and so is unlikely to be the answer. The ^{25}Mg calculation casts doubt on the significance of the results of calculations by Draayer which apparently gave good band head positions. Both calculations illustrate further the dangers of truncation in investigations of this kind. Finally some questions relating to the nature of rotational bands in light nuclei and the effects of three-body forces in the light of recent shell-model results are raised. (auth)

4986 EXCITATION OF GIANT RESONANCES IN ELECTRON AND PROTON SCATTERING. Hammerstein, G. R. (Michigan State Univ., East Lansing); McManus, H.; Moalem, A.; Kuo, T. T. S. Phys. Lett.; 49B: No. 3, 235-238(15 Apr 1974).

Microscopic model calculations are presented for various multipole states in ^{40}Ca. A resonance-like structure largely due to dipole and quadrupole states is predicted in the giant dipole and quadrupole states is predicted in the giant dipole region with qualitatively the same features observed in electron and proton scattering. The calculated cross sections are in good agreement with those obtained from simple phenomenological collective models, and the available scattering experimental data. (auth)

4987 ISOBARIC ANALOG RESONANCES IN ^{35}Cl. Bister, M.; Anttila, A.; Keinonen, J.; Fant, B. (Univ. of Helsinki). Phys. Fenn.; 9: No. 1, 23-38(Mar 1974).

Proton elastic scattering from ^{34}S has been measured with surface barrier detectors in the analog resonance regions at E_p = 1.21, 1.51, 1.90 and 2.07 MeV. For six resonances unique spin and parity assignments, as well as total and proton widths, have been extracted. (auth)

4988 PROPERTIES OF ^{37}Ar. I. Levels Below 3.8 MeV. Gadeken, L. L.; Nolan, P. J.; Butler, P. A.; Green, L. L.; James, A. N.; Sharpey-Schafer, J. F.; Viggars, D. A. (Liverpool Univ.). J. Phys., A (London); 7: No. 1, 83-99(1 Jan 1974).

Excitation energies, mean lifetimes, γ-ray branching ratios, angular correlations, mixing ratios, and linear polarizations were measured for the first twelve levels of ^{37}Ar using the ^{34}S(α,nγ)^{37}Ar reaction. Parity assignments were made for the following levels: 3173, $5/2^+$, 3274, $5/2^-$, 3527, $7/2^-$, and 3602 keV, $3/2^+$ or $5/2^-$. The spin and parity of the 3707 keV state (τ_m = 370 ± 95 fs) was determined, $J^\pi = 11/2^-$. Three new low energy γ-ray transitions were observed, and six new mixing ratios were determined. It was found that the negative parity levels which decay to the 1611 keV $1/2^-$ state are represented qualitatively by the core excitation model. (auth)

4989 EXCITED STATES OF ^{30}P INVESTIGATED THROUGH THE ^{29}Si(^{3}He,d)^{30}P REACTION. Hertzog, R. C.; Green, L. L.; Greene, M. W.; Jones, G. D. (Liverpool Univ.). J. Phys., A (London); 7: No. 1, 72-82(1 Jan 1974).

The Oxford multigap spectrometer was used in a study of the ^{29}Si(^{3}He,d)^{30}P reaction at an incident ^{3}He energy of 15 MeV. Twenty-eight states in ^{30}P were identified up to an excitation energy of about 6 MeV. Parity assignments were made from a DWBA analysis of the angular distributions, spin restrictions were placed on some levels while the 3.731 MeV level was assigned $J^\pi = 1^+$. Spectroscopic factors were obtained and compared with theoretical values. The results are discussed with respect to model calculations. (auth)

4990 LEVELS IN ^{27}Si. Price, H. G.; McCrone, B. T.; Jones, G. D.; Thomas, M. F.; Twin, P. J. (Liverpool Univ.). J. Phys., A (London); 7: No. 1, 58-71(1 Jan 1974).

Angular correlation measurements on levels in ^{27}Si were made using the ^{28}Si(τ,α)^{27}Si reaction at bombarding energies of 13.0 and 15.0 MeV. Spin restrictions and in some cases spin assignments were made for several levels, namely 3.54 MeV ($1/2$, $3/2$) 3.81 MeV ($3/2$, $1/2$), 4.14 MeV ($1/2^-$, $3/2^-$), 4.30 MeV ($5/2^+$), 4.72 MeV ($5/2$, $7/2$), 5.08 MeV ($5/2$). Calculations based upon an excited core model were performed in which the states in ^{27}Si are obtained from coupling quasi-hole excitations from the $d_{5/2}$, $s_{1/2}$ and $d_{3/2}$ orbitals to the ground and first excited states of a ^{28}Si core. The results of the calculations were compared with experiment. (auth)

4991 ^{27}Al(p,γ)^{28}Si REACTION AS A CALIBRATION STANDARD FOR E_γ = 1.5 TO 12.0 MeV GAMMA RAYS. Holmberg, P. (Univ. of Oulu, Finland); Forsblom, I.; Sundius, T. Phys. Fenn.; 9: No. 1, 15-21(Mar 1974).

Six resonances in the ^{27}Al(p,γ)^{28}Si reaction in the proton energy range 990-1800 keV have been chosen for gamma-ray energy and intensity calibration purposes. Average values for the energies of excited states and branching ratios are determined on the basis of published data. In this way the reaction Q-value is found to be Q = 11586.04 ± 0.26 keV. A method for the construction of empirical efficiency curves is also given and demonstrated. (auth)

4992 INFLUENCE OF CHEMICAL BINDING ON THE HALF-LIFE OF ^{24}Na. Chakraborty, S. (Eigenoessisches Institut fuer Reaktorforschung, Wuerlingen, Switzerland). Radiochem. Radioanal. Lett.; 17: No. 1, 61-68(10 Apr 1974). (In German).

The half-life of ^{24}Na in solid NaCl and in its aqueous solution were measured. No change of half-life of ^{24}Na was observed, contrary to a previous report. (auth)

4993 INVESTIGATION OF GAMMA RAYS FROM THE ^{36}S(p,γ)^{37}Cl REACTION. Piiparinen, M.; Viitaslo, M.; Anttila, A. (Univ. of Helsinki). Phys. Scr.; 8: No. 6, 236-238(Dec 1973).

The excitation curve of the ^{36}S(p,γ)^{37}Cl reaction was measured in the proton energy range 1000 to 1900 keV. There were 109 resonances observed. The decay schemes for 13 resonances and energies and branching ratios of 15 bound states were obtained by means of Ge(Li) detectors. Seven of the bound states were not reported earlier. Lifetimes or lifetime limits of 5 bound states were measured by means of Doppler-shift attenuation method. (auth)

4994 ANGULAR CORRELATION MEASUREMENTS ON LEVELS IN ^{29}Si ABOVE 5 MeV EXCITATION. Viggars, D. A.; Butler, P. A.; Carr, P. E.; Gadeken, L. L.; Green, L. L.; James, A. N.; Nolan, P. J.; Sharpey-Schafer, J. F. (Univ. of Liverpool). J. Phys., A (London); 7: No. 3, 360-371(11 Feb 1974).

Angular correlation measurements have been made in ^{29}Si to determine spins and mixing ratios using the reaction ^{26}Mg(α,n)^{29}Si. The following spin and parity assignments have been made: E_x = 6.616 MeV, $J^\pi = 5/2^+$; E_x = 7.069 MeV, $J^\pi = (3/2^+, 1/2)$; E_x = 7.139 MeV, $J^\pi = 11/2^+$; E_x = 8.331 MeV, $J = (5/2, 3/2)$; E_x = 8.476 MeV, $J^\pi = (1/2^+, 11/2^+)$; E_x = 8.641 MeV, $J^\pi = 9/2^+$; E_x = 8.861 MeV, $J^\pi = (3/2^-, 5/2)$. Previously undetermined mixing ratios have been measured for the following transitions: (5.653 MeV-4.742 MeV), $\delta = -0.02 \pm 0.20$; (5.813 MeV-3.068 MeV), $\delta = -0.06 \pm 0.03$. Mixing ratio alternatives were found for seven other transitions. The levels at 7.069, 7.522, 8.331, and 8.476 MeV were found to have mean lifetimes $\tau < 15$ fs, those at 8.641 and 8.861 MeV have mean lifetimes $\tau < 40$ fs. (auth)

4995 QUASIFREE $\alpha-\alpha$ SCATTERING IN THE REACTION ^{20}Ne(α,2α)^{16}O AT 80 MeV. Epstein, M. B. (California State Univ., Los Angeles); Margaziotis, D. J.; Miyazono, C. K.; Cahill, T. A.; King, N. S. P. pp 957-959 of Few Particle Problems in

the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Much interest was shown recently in alpha clustering studies in light nuclei. Alpha clustering in ^{20}Ne was investigated in the past using the reaction ^{20}Ne(p,pα)^{16}O at E_p = 46 MeV. This work showed essentially no evidence of quasifree p−α scattering, with the reaction proceeding primarily through the sequential decay mode. The lack of such evidence was probably due to the relatively low incident proton energy. Results obtained using the reaction ^{20}Ne(α,2α)^{16}O at 78.6 MeV are reported. Data taken at 43 to 43° are dominated by quasifree $\alpha-\alpha$ scattering but also show evidence for the sequential decay mode. The data at 30 to 56° also show strong quasifree scattering with weak sequential processes. A PWIA calculation fits these data quite well. It is concluded that α-clustering is important in the ^{20}Ne(α,2α)^{16}O (g.s.) reaction but that the PWIA describes the data reasonably well only for those kinematical conditions that allow the spectator momentum to be quite small. (auth)

4996 TRANSFER REACTIONS: LIGHT IONS TRANSFER. pp 432-458 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Twenty-seven papers on this topic are presented. Pickup and stripping reactions involving transfer of up to three nucleons and initiated by beams no heavier than A = 4 are discussed. Some attention is also given to knock-out reactions. Targets range from ^{208}Pb to deuterium (in the Barshay−Temmer symmetry test in the α + D reaction). Reaction kinetics and properties of residual nuclei are investigated. (RWR)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 2502, 4823, 4844, 4936, 4937, 4940, 4966, 4968−4970, 4972, 4976, 4982, 4984, 4987, 4996, 5030, 5033, 5049, 5053, 5054, 5056, 5081, 5084, 5091, 5094, 5134, and 5188.

4997 (JAERI-1228, pp 106-116) ANALYSIS OF FAST NEUTRON SCATTERING USING THE COUPLED-CHANNELS THEORY. Tanaka, S. (Japan Atomic Energy Research Inst., Tokai). Jul 1973. (In Japanese).

The experimental data for the angular distributions of neutrons scattered from Cr, Fe, Ni, Zn, ^{120}Sn, and Gd were compared with calculations using both the spherical model and the coupled-channels theory. The method of the analysis is similar to the previously reported one for ^{139}La, ^{141}Pr, and Er in the energy range of 1.5−3.5 MeV, but the energy range in the present analysis is extended up to 8 MeV, in case there are experimental data available. The optical-potential parameters used in both the calculations were determined from comparison of the theoretical calculations with the measured values for ^{209}Bi. The values of coupling parameters in the coupled-channels calculations were taken from a published bibliography. In almost all cases, the angular distributions calculated with the coupled-channels theory fit the experimental values better than those calculated with a spherical potential. (auth)

4998 (JAERI-1228, pp 157-163) SCATTERING OF 14 MeV NEUTRONS. Matoba, M. (Kyushu Univ., Fukuoka). Jul 1973. (In Japanese).

The current stage of the measurement and the analysis for 14 MeV neutron scattering cross-sections is discussed. For studying some of the problems discussed, a new experimental facility was installed in Kyushu University. The energy resolution of the system is the best (≤ 300 keV) in the 14 MeV neutron time-of-flight spectrometers being reported up to now. (auth)

4999 OBSERVATION AND INTERPRETATION OF ANGULAR OSCILLATIONS IN ^{48}Ca(^{14}N, ^{13}C)^{49}Sc. Chasman, C.; Kahana, S.; Schneider, M.J. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 31: No. 17, 1074-1076 (22 Oct 1973).

We describe a detailed and successful experimental search for fine angular oscillations in the reaction ^{48}Ca(^{14}N, ^{13}C)^{49}Sc at a laboratory energy of 50 MeV. Also presented is a qualitative, analytic description of the reaction extracted from the distorted-wave Born-approximation partial-wave analysis in which the universality of the oscillations is clearly indicated. (auth)

5000 EXCITATION OF GIANT RESONANCES IN ^{58}Ni VIA INELASTIC SCATTERING OF POLARIZED PROTONS. Kocher, D.C.; Bertrand, F.E.; Gross, E.E.; Lord, R.S.; Newman, E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. Lett. 31: No. 17, 1070-1073 (22 Oct 1973).

Measurements of the analyzing power and the differential cross section in the nuclear continuum for the reaction ^{58}Ni(p,p) initiated by 60-MeV polarized protons provide strong evidence for a quadrupole (E2) interpretation for the giant resonance at $E_x \simeq 63/A^{1/3}$ MeV. A resonance approximately 3 MeV lower in excitation energy has also been observed. (auth)

5001 GAMMA-RAY SPECTROSCOPY IN A≃40 NUCLEI VIA HEAVY-ION-INDUCED REACTIONS: HIGH-SPIN STATES IN ^{41}K AND ^{41}Ca. Gorodetzky, P.; Kolata, J.J.; Olness, J.W.; Poletti, A.R.; Warburton, E.K. (Brookhaven National Laboratory, Upton New York 11973). Phys. Rev. Lett. 31: No. 17, 1067-1070 (22 Oct 1973).

Compound-nuclear reactions induced by bombardment of ^{24}Mg, ^{26}Mg, and ^{27}Al targets with 20–60-MeV ^{16}O, ^{18}O, and ^{19}F beams have been used to study γ transitions between high-spin states in nuclei in the mass region $32 \leq A \leq 44$. Results for ^{41}K and ^{41}Ca are presented to exemplify the method and results. The γ-ray decay of states with probable spins up to 19/2 are observed in both nuclei. (auth)

5002 STUDY OF EXCITED STATES OF ^{39}Ca AND ^{39}K. Kessel, W. (Inst. fuer Kernphysik, Frankfurt am Main); Bass, R.; Hagen, E. C.; Roberson, N. R.; Gould, C. R.; Tilley, D. R. Nucl. Phys.; A223: No. 2, 253-267(1974).

States in ^{39}Ca up to 4 MeV excitation energy were studied with the ^{36}Ar(α,nγ)^{39}Ca reaction. Outgoing γ-rays were measured in coincidence with either neutrons or γ-rays detected at 0° with respect to the beam axis. Excitation energies for levels in ^{39}Ca were measured; doublets were found near 3.88 and 3.95 MeV. Mean lifetimes of excited states were determined by the Doppler-shift attenuation method. The results are 90 ± 24 ps, 24 ± 15 ps and 30 ± 25 ps for the levels at 2.80 MeV, 3.64 MeV and 3.95 MeV in ^{39}Ca, respectively. Upper limits on the mean lifetimes of several other states were determined. From the γ-γ coincidence data, a mean lifetime of 18 ± 10 ps was deduced for the state at 5.16 MeV in ^{39}K. The results are compared with existing data and theoretical calculations. (auth)

5003 STRUCTURE IN THE GIANT RESONANCE OF ^{55}Mn. Carchon, R.; Devos, J.; Van de Vyver, R.; Van Deynse, C.; Ferdinande, H. (State Univ., Ghent). Nucl. Phys.; A223: No. 2, 416-422(1974).

The total photoneutron cross section for ^{55}Mn was measured from threshold to 23 MeV with a bremsstrahlung beam from the linac and by direct detection of the neutrons. The analysis of the yield curves using both the variable-bin Penfold and Leiss unfolding technique and the least-structure method of Cook gave consistent results. The gross structure of the cross section resembles the one predicted by the dynamic collective model theory, while the fine structure, predominantly in the leading edge of the giant resonance, seems to be in agreement with a photoproton experiment and with recent photoneutron work. (auth)

5004 ISOSPIN SPLITTING OF TWO PARTICLE-TWO HOLE STATES. Zamick, L. (Department of Physics, Rutgers University, New Brunswick, N.J. 08903). Ann. Phys. (N.Y.) 77: No. 1, 230-249 (1 May 1973).

If one attempts to express the isospin splittings of two particle-two hole states in terms of the energies of one particle-one hole states, then very bad answers come out if one limits oneself to very simple configurations for the 1p-1h states and chooses an interaction which will fit their energies. This may be viewed as a failure of the simple effective interaction method. In this work a formalism, which takes account of the complexity of the one particle-one hole states either in T.D.A. or R.P.A., is used. This may be regarded as extending the use of the R.P.A. to two particle-two hole states. (auth)

5005 REORIENTATION MEASUREMENTS IN THE EVEN NICKEL ISOTOPES. Lesser, P. M. S.; Cline, D.; Kalbach-Cline, C.; Bahnsen, A. (Univ. of Rochester, NY). Nucl. Phys.; A223: No. 3, 563-576(1974).

The reorientation effect in Coulomb excitation was used to measure the static electric quadrupole moments, Q_{2^+}, of the first excited (2_1^+) states in ^{58}Ni and ^{60}Ni. A 70 MeV beam of ^{32}S ions was used to excite the 2_1^+ states and the de-excitation γ-rays were observed in coincidence with scattered particles, using a multiple detector system. The results of these measurements are in excellent agreement two previous Rochester measurements which employed different experimental techniques. A weighted average of all Rochester measurements gives: $Q_{2^+}(^{58}\text{Ni}) = -0.10 \pm 0.06$ e · b and $Q_{2^+}(^{60}\text{Ni}) = +0.03 \pm 0.05$ e · b, ignoring the possible effects of higher excited 2^+ states in both cases. The experimental results are compared with shell model calculations assuming an inert ^{56}Ni core with valence neutrons in the $p_{\frac{3}{2}}$, $f_{\frac{5}{2}}$, and $p_{\frac{1}{2}}$ orbitals. (auth)

5006 LIFETIME MEASUREMENTS OF STATES IN ^{41}Ca AND ^{41}K. Lieb, K. P.; Uhrmacher, M.; Dauk, J.; Kleinfeld, A. M. (Univ., Cologne). Nucl. Phys.; A223: No. 3, 445-461(1974).

Measurements of the γ-ray decay of states in ^{41}Ca and ^{41}K populated in the reactions ^{27}Al(^{16}O,pn) and ^{27}Al(^{18}O,2p) were performed. Using the recoil distance Doppler shift method, mean lifetimes were determined for states in ^{41}Ca at 3370 keV (28 ± 5 ps), 3830 keV (4.4 ± 0.3 ns) and 3915 keV (2.6 ± 0.8 ps), and in ^{41}K at 2528 keV (230 ± 12 ps), 2761 keV ($1.3^{+0.7}_{-0.4}$ ps), 2774 keV (74 ± 8 ps) and 4983 keV (101 ± 5 ps). The 3370 and 3830 keV states in ^{41}Ca are suggested to be $J^\pi = 11/2^+$ and $15/2^+$, respectively, having predominantly 2p–1h configurations. These suggestions contradict a recent interpretation of these states as being members of a strongly deformed $K = 3/2^-$ rotational band. (auth)

5007 ROLE OF OPTICAL-MODEL PARAMETERS IN ESTIMATION OF AVERAGE REACTION CROSS SECTIONS. Kulkarni, A. B.; Sharma, H. C.; Nath, N. (Kurukshetra Univ., India). Indian J. Pure Appl. Phys.; 11: No. 6, 388-390(Jun 1973).

The role of individual optical model potential parameters used for estimation of the average reaction cross section [Sharma, H. C., et al., Progr. Theo. Phys. Japan, 47 (1972), 1797] was critically examined, and the extent of the reliability of the theoretical predictions obtained through such a model was briefly discussed. (auth)

5008 ANGULAR DISTRIBUTIONS OF 2.9-MeV NEUTRONS SCATTERED BY ^{54}Fe NUCLEI. Fedorov, M. B.; Yakovenko, T. I. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 152-153(Jan 1974). (In Russian).

The experimental angular distributions of 2.9-MeV neutrons scattered by ^{54}Fe nuclei were analyzed on the basis of the statistical theory and the optical model of the nucleus. Consideration of the strong bond of the channel reaction improves the agreement of the calculated and experimental angular distributions of inelastic neutron scattering. (tr-auth)

5009 ISOSPIN EFFECTS IN FAST NEUTRON RADIATIVE CAPTURE. Nilsson, L. (Tandem Accelerator Lab., Uppsala); Eriksson, J. Phys. Lett.; 49B: No. 2, 165-167(1 Apr 1974).

The effect of isospin splitting of the giant dipole resonance of the final nucleus on neutron capture cross sections in N = Z nuclei is discussed. The ^{40}Ca(n,γ) ground-state transition is taken as an example. The suggested modification of the semi-direct capture model gives an improved description of the energy dependence of the ^{40}Ca(n,γ_0) cross section. (auth)

5010 (p,t) REACTIONS ON ODD-A NUCLEI AND THE WEAK-COUPLING CORE-EXCITATION MODEL. Seth, K. K. (Northwestern Univ., Evanston, IL); Saha, A.; Stewart, W.; Benenson, W.; Lanford, W. A.; Nann, H.; Wildenthal, B. H. Phys. Lett.; 49B: No. 2, 157-160(1 Apr 1974).

Excited $1/2^-$ states to which enhanced L = 0 (p,t) transitions are observed have been identified in ^{41}Ca at 2958 keV and in ^{57}Co at 2611 keV. A comparison of these (p,t) transitions with those to the 0^+ states in ^{40}Ca at 3353 keV and in ^{58}Ni at 2940 keV leads to the conclusion that these states are obtained by weak-coupling of an $f_{7/2}$ particle and hole, respectively, to the excited 0^+ states of the doubly even cores. It is suggested that these cases are examples of a rather general weak-coupling phenomenon. (auth)

5011 MAGNETIC MOMENT OF THE 3^- LEVEL AT 29.5 keV IN ^{40}K. Brandolini, F. (Univ., Padua); Rossi Alvarez, C.; Vingiani, G. B.; de Poli, M. Phys. Lett.; 49B: No. 3, 261-262(15 Apr 1974).

The g-factor of the 3^- level at 29.5 keV in ^{40}K was measured to be -0.43 ± 0.03 with the spin precession method. The half-life was redetermined to be 4.30 ± 0.06 ns. The experimental g-factor is consistent with an effective moment approach. (auth)

5012 TWO PARTICLE WAVE FUNCTIONS IN A STURM–LIOUVILLE BASIS. Gareev, F. A. (Univ. of Copenhagen); Bang, J.; Yamaleev, R. M. Phys. Lett.; 49B: No. 3, 239-242 (15 Apr 1974).

Wave functions and energies of 0^+ states of ^{42}Ca are calculated by means of the Sturm–Liouville expansion, thus taking into account "continuum admixtures". The wave functions are used in calculations of formfactors for two-particle transfer. (auth)

5013 ROLE OF THE 4p–4h EXCITATIONS IN THE MICROSCOPIC DESCRIPTION OF ^{56}Ni. Gmitro, M. (Nuclear Research Inst., Rez, Czech.); Rimini, A.; Weber, T. Nuovo Cim.; 21A: No. 1, 11-31(1 May 1974).

An effective Hamiltonian for shell model calculations in the middle of the 2p-1f shell is microscopically deduced from the Tabakin nucleon–nucleon potential. Its matrix elements are tabulated. Such a Hamiltonian is applied to the description of ^{56}Ni. All configurations up to four particle-hole excitations are considered and a weak-coupling assumption is used to select the relevant shell model states. The weak-coupling assumption turns out to be very effective in reducing the dimensions of the secular matrices. No phenomenological parameter is used. Only a small adjustment of the $1f_{7/2}$–$2p_{3/2}$ gap with respect to its theoretical value is allowed. The adopted value is 2.65 MeV. The inclusion of the 4p-4h configurations is essential to get a reasonable agreement between the theoretical and experimental spectra of ^{56}Ni. The ground state turns out to be 61% closed and 36% 2p-2h, while the excited states are almost pure 4p-4h. (auth)

5014 γ-DECAY OF A $p_{\frac{1}{2}}$ ANALOG STATE IN ^{51}Mn. Schrader, M. (Univ., Hamburg); Buchholz, K.; Klapdor, H. V. Nucl. Phys., A223: No. 2, 365-380(1974).

A high-accuracy investigation of the γ decay of the E_p = 1059- and 1071-keV resonances in the reaction ^{50}Cr(p,γ)^{51}Mn was performed. The E_p = 1059-keV resonance is shown to be the analog state corresponding to the E^* = 1899 keV, $J^\pi = 3/2^-$ parent state in ^{51}Cr. From (p,γ) angular distributions, mixing ratios of the primary γ transitions depopulating this resonance and J^π values of many states populated in the γ decay were determined. The total γ width of this 1059-keV resonance was found to be Γ_γ = 0.055 eV. The analog–antianalog transition strength was 0.009 W.u., and fitted well into systematics of IAS → AIAS transitions in f–p-shell nuclei. The main part of the M1 strength in the γ decay of the IAS is absorbed in $1/2^-$ and $3/2^-$ core polarized states. A comparison of the level scheme of ^{51}Mn obtained from the decay schemes of the (p,γ) resonances with calculations in the Coriolis-strong-coupling model shows evidence for a g.s. deformation of ^{51}Mn. (8 figures, 3 tables) (auth)

5015 DECAY OF ^{48}V. Metskhvarishvili, R. Ya.; Miminoshvili, Z. N.; Elizbarashvili, M. A. (Tbilissi State Univ., USSR). Yadern. Fiz.; 19: No. 3, 473-478(Mar 1974). (In Russian).

The positron spectrum of ^{48}V was investigated by means of the magnetic β spectrometer with a small background. It is established that the β^+ decay of ^{48}V proceeds to excited states of ^{48}Ti with energies of 983.3 and 2294.7 keV. For the positron boundary energies the following values are obtained: 2013 ± 46, 698 ± 7, and 560 ± 50 keV. For lg(ft) the values of 11.0 ± 0.3 and 8.5 ± 1.0 are obtained at the transitions to the states 983.3 and 2421 keV, respectively. (auth)

5016 GIANT RESONANCES AND PHOTONUCLEAR REACTIONS. pp 632-661 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Thirty papers on these topics are presented. The incident beams included photons, protons, neutrons, electrons, tritons, ^{3}He, and alpha particles. Although most of the targets were light nuclei, ^{89}Y, ^{110}Cd, ^{140}Ce, and even ^{176}Lu were studied. Excitation energies, level densities, reaction mechanisms, and effective charges were deduced. (RWR)

5017 LIFETIME MEASUREMENTS IN ^{59}Ni AND ^{57}Ni. Pichevar, M.; Delaunay, J.; Delaunay, B. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A224: No. 1, 34-44(1974).

The Doppler-shift attenuation method (DSAM) was used to measure the lifetime of 11 levels in ^{59}Ni (4 were measured for the first time) and 2 in ^{57}Ni. From these measurements, accurate excitation energies were determined for the levels below 2.8 MeV in ^{59}Ni. A complete line-shape analysis was performed on the basis of the description of the stopping process of the recoiling nuclei given by Warburton et al. The measurements were made using the ^{56}Fe(α,nγ)^{59}Ni and ^{54}Fe(α,nγ)^{57}Ni reactions at bombarding energies between 7.5 and 10.5 MeV for ^{58}Ni and at 9 MeV for ^{57}Ni. Enriched targets were used. The lifetimes of the states in ^{59}Ni obtained with four different stopping materials (C, Fe, Cu, Au) were found to be consistent. The results are compared with recent shell model calculations. (auth)

5018 ACTIVATION CROSS-SECTIONS FOR 14.7 MeV NEUTRONS ON CHROMIUM. Holmberg, P.; Rieppo, R.; Keinaenen, J. K. (Oulu Univ., Finland). J. Inorg. Nucl. Chem.; 36: No. 4, 715-717(Apr 1974).)

By using the activation method, the cross-sections for the following reactions were measured: ^{50}Cr(n,2n)^{49}Cr, 24 ± 5 mbarn; ^{52}Cr(n,p)^{52}V, 94 ± 10 mbarn; ^{53}Cr(n,p)^{53}V, 40 ± 7 mbarn; ^{54}Cr(n,p)^{54}V, 15 ± 4 mbarn; ^{54}Cr(n,α)^{51}Ti, 7 ± 4 mbarn. The neutron energy was 14.7 ± 0.3 MeV. (auth)

5019 QUADRUPOLE COLLECTIVITY AND POSSIBLE EXISTENCE OF MACROSCOPIC SU(3) SYMMETRY IN SOME

COLLECTIVE SHELL MODEL STATES. Bhatt, K. H. (Physical Research Lab., Ahmedabad, India); Parikh, J. C.; McGrory, J. B. Nucl. Phys.; A224: No. 2, 301-318(1974).

The shell model eigenfunctions for low-lying states of ^{56}Fe and ^{54}Cr are analyzed to illustrate that the "collective" states of these nuclei can be described as the coupling of a small number of low-lying collective states of the proton and neutron groups. A truncation scheme for doing shell model calculations which would take advantage of the multipole collectivity of the low-lying states of the proton and neutron states is discussed. Finally, it is suggested that the rotational features observed even in the heavy deformed nuclei would be a consequence of the existence of what might be called an approximate "macroscopic" SU(3) symmetry. (auth)

5020 SEMI-MICROSCOPIC CALCULATION OF THE LEVEL DENSITY IN SPHERICAL NUCLEI. Soloviev, V. G.; Stoyanov, Ch.; Vdovin, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A224: No. 2, 411-428(1974).

The level density at the neutron binding energy for 90 spherical nuclei in the interval $50 < A < 205$ is calculated by a method of direct counting of the number of states taking into account collective vibrational excitations. The results of calculations are in satisfactory agreement with the experimental data. The difference in the level density of doubly even and odd-A nuclei is correctly described. The effect of nuclear vibrations on the level density is studied, and it is shown that the account of them leads to an increase in the density by a factor of 1.5 to 10 and to a decrease in the density fluctuations. It is also studied how the level density depends on excitation energy. With increasing excitation energy, the results come nearer the corresponding values obtained by the statistical model. It is found that the density fluctuations decrease with increasing excitation energy but remain still strong at the neutron binding energy for nuclei with A = 50 to 70 and for nuclei around closed shells. The density $\rho(I^{\pi})$ is studied as a function of spin and parity. It is shown that at the neutron binding energy the ratio $\rho(I^{+})/\rho(I^{-})$ is different from unity for the majority of nuclei. This difference is especially striking for ^{57}Fe and ^{58}Fe nuclei. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 4291, 4920, 4921, 4956, 4968, 4970, 4982, 4984, 4996, 4997, 5007, 5010, 5016, 5017, 5020, 5049, 5053, 5054, 5057, 5084, 5092, 5134, and 5136.

5021 INTERACTION OF FAST NEGATIVE PIONS WITH ^{60}Ni. Jackson, H.E.; Meyer-Schützmeister, L.; Wangler, T.P. (Argonne National Laboratory, Argonne, Illinois 60439); Redwine, R.P.; Segel, R.E.; Tonn, J.; Schiffer, J.P. Phys. Rev. Lett. 31: No. 22, 1353-1355 (26 Nov 1973).

The γ-ray spectra resulting from the bombardment of ^{60}Ni and ^{28}Si with 500-MeV/c negative pions were measured. For ^{60}Ni, lines were present from the decay of first excited states of ^{56}Fe (^{60}Ni-1α), ^{52}Cr(^{60}Ni-2α), and ^{48}Ti(^{60}Ni-3α). Single neutron removal was not observed. Similar results were obtained for ^{28}Si. A comparison is made with results obtained with stopped K and proton beams. (auth)

5022 DIFFERENTIAL CROSS SECTIONS FOR THE ELASTIC SCATTERING OF γ-RAYS FOR ENERGIES FROM 145 keV TO 750 keV. Smend, F.; Schumacher, M. (Univ., Goettingen, Ger.). A223: No. 2, 423-428(1974).

Differential cross sections for the elastic scattering of γ-rays for energies between 145 and 750 keV and for charge numbers from 30 to 82 are presented for scattering angles ranging from 45 to 135°. These differential cross sections were calculated using form factors and "corrected form factors" obtained from relativistic HFS wave functions and using a semi-empirical procedure for obtaining accurate scattering amplitudes from the form factors. For an easy extension of the tabulation, exact analytical expressions based on relativistic hydrogen wave functions are presented for both form factors and all subshells of the atom. Effective charge numbers are given providing close agreement between form factors calculated from relativistic hydrogen wave functions and from relativistic HFS wave functions. (auth)

5023 EFFECT OF THE COMPLEX DENSITY STRUCTURE IN THE GIANT RESONANCE REGION ON THE NUCLEI ^{60}Ni, ^{90}Zr, AND ^{208}Pb. Zivopistsev, F. A.; Lukashev, A. V.; Shitikova, K. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2634-2637(Dec 1973). (In Russian).

The distribution function of complex states is studied on a microscopic basis, principally one-particle levels. Distribution functions of the multiparticle-multihole levels are also calculated for ^{60}Ni, ^{90}Zr, and ^{208}Pb for different states $T_<$ and $T_>$ both in the giant resonance region and at high excitation energies. The results are graphed. (JSR)

5024 ELASTIC AND INELASTIC SCATTERING OF PROTONS WITH ENERGY OF 6 MeV ON FOUR ISOTOPES OF ZINC. Antropov, A. E.; Gusev, V. P.; Drebez, L. G.; Zarubin, P. P.; Ioannu, P. D.; Orlov, B. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2649-2656(Dec 1973). (In Russian).

The angular distributions of the elastic scattering of 6.02-MeV protons on ^{64,66,68,70}Zn are measured. Sets of parameters of optical potential, describing by the optical model the elastic scattering, and calculations from the Khauzer-Feshbakh theory are reported. Experimental results are obtained on the angular distributions of the inelastic scattering of protons. Experimental results on the inelastic scattering are analyzed by the Khauzer-Feshbakh theory for the first 2_1^+ state and by the wave distortion method with evolution of the deformation parameter β_2 for the nuclei studied. (tr-auth)

5025 DISINTEGRATION OF ^{88}Y. Ardisson, G.; Laribi, S.; Marsol, C. (Institut d'Etudes Nucleaires, Alger). Nucl. Phys.; A223: No. 3, 616-619(1974). (In French).

Radioactive decay of ^{88}Y was reinvestigated using coaxial Ge(Li) detectors. Energies and intensities of six γ-rays were measured. A new γ-ray of 850.6 keV was found showing that the 3584 keV level in ^{88}Sr is fed in this decay. The log ft value for this level is consistent with a $J^{\pi} = 4^-, 5^-$ assignment. A 3522 keV level reported elsewhere was not found. (auth)

5026 DETERMINATION OF THE REACTOR NEUTRON CROSS SECTION OF NICKEL-63. Michael, H.; Neubert, A.; Nickel, H. (Kernforschungsanlage, Juelich, Ger.). Int. J. Appl. Radiat. Isotop.; 25: No. 4, 183-185(Apr 1974).

Upon irradiation of stainless steel-clad fuel elements ^{63}Ni is built up in large amounts which depend among other factors on the neutron cross sections σ_{62} and σ_{63}. To determine the cross section of ^{63}Ni a highly enriched sample of ^{62}Ni (>99%, ^{63}Ni <0.1%) was irradiated. Mass spectrometric measurement of the isotopic composition of the starting material and the irradiated sample give the data needed for the evaluation of σ_{63} and σ_{62}. A double focusing mass spectrometer equipped with a Knudsen cell was used. The ion currents were measured by pulse counting. The resulting reactor neutron cross sections were: $\sigma_{63} = 25.7 \pm 3$ barn and $\sigma_{62} = 14.8 \pm 0.8$ barn. (auth)

5027 TRANSITIONS TO THE ISOMERIC LEVELS IN ^{79,81}Br PRODUCED INDIRECTLY BY COULOMB EXCITATION. Cottrell, C. W. (Oxford Univ.). J. Phys., A (London); 7: No. 1, 100-106 (1 Jan 1974).

Observations were made of the transition from the 762 keV, $7/2^-$ level to the 207 keV, $9/2^+$ isomeric level in ^{79}Br. The $7/2^-$ level was populated by Coulomb excitation using alpha particles as the projectiles. Measurements were made on both the singles gamma ray spectra and the delayed $9/2^+ \rightarrow 7/2^-$ (GS) isomeric transition. The strength of the transition was such as to give a branching ratio of (3.6 ± 0.4)% from the $7/2^-$ level. An upper limit of 0.3% was obtained for the equivalent branch in ^{81}Br. (auth)

5028 1f2p NUCLEI. Search for the Particle-Plus-Core Excitation Mode in ^{65,67,69}Ga. Harms-Ringdahl, L.; Sztarkier, J.; Sawa, Z. P. (Research Inst. for Physics, Stockholm). Phys. Scr.; 9: No. 1, 15-25(Jan 1974).

The γ-ray decays of the states in ^{65}Ga*, ^{67}Ga* and ^{69}Ga* were studied using the reactions ^{64}Zn(d,n) at E_d = 7.1 MeV, ^{64}Zn(α,p) and ^{66}Zn(α,p) at E_α = 12.2 and 14.2 MeV, ^{63,65}Cu(α,2n) at E_α = 24 and 31 MeV. By measuring γ−γ and p−γ coincidences, angular distributions and yields of the transitions as a function of incident energies for ten states in ^{65}Ga, sixteen states in ^{67}Ga and nine states in ^{69}Ga were established or confirmed. The validity of the particle-plus-vibrational core coupling scheme for ^{65,67,69}Ga is considered in view of these data. (auth)

5029 1f2p NUCLEI. Gamma Ray Spectroscopy on States in ^{65}Zn and ^{67}Zn Using ^{62,64}Zn(α,n) Reactions. Nilsson, A.; Sawa, Z. P. (Research Inst. for Physics, Stockholm). Phys. Scr.; 9: No. 2, 83-95(Feb 1974).

The structure of ^{65}Zn and ^{67}Zn was investigated by studying the yield function, angular distribution, linear polarization, and coincidence relation of the γ-rays emitted during bombardment of enriched ^{62,64}Ni foils by α-particles of energy 14 MeV and lower. Additional information on the yield of transitions in ^{65}Zn* was obtained in the Cu(α,pn) reaction at incident energies 24 MeV and 31 MeV. High spin states up to $13/2^-$ and $15/2^+$ were assigned. The negative parity states are discussed in the framework of the seniority coupling scheme for the neutrons and in the framework

of the particle-plus-core coupling scheme. Concerning the positive parity states strong indications are found that the simple $lg^8_{/2} \otimes$ core coupling scheme is valid. (auth)

5030 1f2p NUCLEI. SENIORITY-THREE STATES OF THE $\nu(2p_{3/2}, 1f_{5/2}, 2p_{1/2})^3$ CONFIGURATION IN ^{59}Ni. Monseu, P.; Forssten, K.; Sawa, Z. P. (Research Inst. for Physics, Stockholm). Phys. Scr.; 9: No. 1, 26-32(Jan 1974).

The electromagnetic decay properties of the residual states in ^{59}Ni formed by the ^{56}Fe(α,n)^{59}Ni*(γ) reaction have been studied at α-particle incident energies between 10 and 14 MeV by measuring yield function, angular distribution and linear polarization of the γ-transitions and $\gamma-\gamma$ coincidences. The non-stripping states at excitation energies 1 338.0 keV, 1 767.5 keV, and 2 705.0 keV have been assigned uniquely as $^7/_2^-$, $^5/_2^-$, and $^{11}/_2^-$, respectively, and identified as the expected seniority-three states of the $\nu(2p_{3/2}, 1f_{5/2}, 2p_{1/2})^3$ configuration. The dipole-quadrupole mixing ratios have been obtained for the transitions. (auth)

5031 G-FACTOR OF THE 1291.5 keV STATE IN ^{59}Co. Bargholtz, C.; Beshai, S.; Eriksson, L.; Froeberg, L. E.; Gidefeldt, L. (Univ. of Stockholm). Phys. Scr.; 9: No. 2, 79-82(Feb 1974).

The g-factor of the 1 291.5 keV state in ^{59}Co was determined by the IPAC method. A multichannel goniometer was used in the study of the perturbed angular correlation of the 142.5 to 1 291.5 keV cascade. Four sources were used, ^{59}Fe:Fe, ^{59}Fe:Co, ^{59}Fe:Ni, and ^{59}Fe:Cu. The g-factor was found to be 1.69(8) based on an analysis of the iron, nickel, and copper data. The corresponding magnetic moment, μ = 2.54 (12) μ_N, is compared with the prediction of a unified vibrational model. Neglecting the static electric quadrupole interaction between the ^{59}Co nucleus and its environment in cobalt metal, the magnetic hyperfine field experienced by ^{59}Co in cobalt was found to be -217 (22) kG at room temperature. (auth)

5032 NUCLEAR STRUCTURE OF ^{63}Ni BY IAR. Ramavataram, K.; Mercier, G. F.; St-Pierre, C.; Sykes, D.; Yang, C. S.; Ramavataram, S. (Univ. Laval, Quebec). Can. J. Phys.; 52: No. 5, 402-405(1 Mar 1974).

The resonances of the low excited states of ^{63}Ni were studied by bombarding targets of ^{62}Ni with protons of energies between 2.5 and 5.0 MeV. Spins as well as the elastic and inelastic widths for some of these states were determined. The spectroscopic factors that were deduced are compared with shell model predictions. (auth)

5033 ANALOG STATES. pp 560-579 OF PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Twenty papers on this topic are presented. They deal with the study of nuclear structure through the excitation of isobaric analog resonances. ^{61}Cu, ^{211}Po, ^{211}Bi, ^{47}V, ^{51}Mn, ^{77}Br, ^{25}Mg, ^{17}F, ^{29}Si, and ^{138}Ba are among the nuclides specifically investigated. Aspects of reactions used to excite analog states were also considered. (RWR)

5034 LEVEL STRUCTURE OF ^{75}Se BY THE ^{75}As(p,nγ)^{75}Se REACTION. Sugimitsu, T. (Kyusyu Univ., Fukuoka). Nucl. Phys.; A224: No. 1, 199-220(1974).

Excitation functions of γ-rays from the ^{75}As(p,n)^{75}Se reaction were measured with 2.0 to 3.6 MeV protons to establish the level scheme of ^{75}Se up to about 1.5 MeV excitation energy. Internal conversion electrons following the same reaction were measured at 4.5 and 5.0 MeV proton energy. Using theoretical predictions of the statistical compound nucleus model together with deduced internal conversion coefficients, unique spin assignments were obtained for the 112.5($^7/_2^+$), 427.9($^5/_2^-$), and 663.9($^7/_2^-$) keV levels. Probable spins were proposed to the 286.6 ($^5/_2^-$ for one of the doublet and $^5/_2^-$ or $^7/_2^-$ for the other), 579.4 ($^5/_2^-$ or $^7/_2^-$), 585.8 ($^5/_2^-$ or $^{11}/_2^-$) and 747.6 ($^5/_2^-$ or $^7/_2^-$) keV levels. A low lying $^9/_2^+$ level was tentatively assigned at 133.2 keV excitation energy. It was found that a low lying $^1/_2^-$ level which appears systematically in other odd Se nuclei is absent in ^{75}Se. (auth)

5035 ENERGY LEVELS OF ^{62}Ni USING THE (γ,γ') REACTION. Moreh, R.; Wolf, A.; Jacob, L.; Nof, A. (Nuclear Research Center, Beersheba, Israel). Nucl. Phys., A224: No. 1, 86-92 (1974).

Elastic and inelastic scattering of monochromatic photons were used for studying nuclear energy levels in ^{62}Ni; the photons were produced by thermal neutron capture in iron. The energy of the resonance level in ^{62}Ni was 7646 keV. The angular distributions of the elastic and two inelastic lines were measured and the corresponding level spins determined. The parity of the resonance level was found to be odd using polarization measurements. (auth)

5036 EFFECT OF CORRELATION ON THE EXCITATION PROBABILITY Kr $4p^6 \rightarrow$ Rb$^+$ $4p^55p$ FOLLOWING β-DECAY. Froese Fischer, C. (Univ. of Waterloo, Ont.). Z. Phys.; 266: No. 3, 161-165(Jan 1974).

Through use of a multi-configuration Hartree-Fock (MCHF) approximation for the stationary states, the effect of correlation on the excitation probability, Kr $4p^6\ ^1S \rightarrow$ Rb$^+$ $4p^55p\ ^1S$ is studied. It is shown that the MCHF approximation equivalent to a nonorthogonal Hartree-Fock approximation is the most important correction to the Hartree-Fock total wave function, and that the remaining correlation, though significant, has a much smaller effect. (3 tables) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 2864, 3297, 3315, 4110, 4815, 4826, 4920, 4922-4924, 4956, 4968, 4970, 4982, 4984, 4996, 4997, 5007, 5016, 5020, 5022, 5023, 5080, 5081, 5084, 5087, 5094, 5100, 5114, 5117, 5146, 5149, 5161, 5184, 5188, 5195, and 5356.

5037 (CONF-720724-P2, pp 63-68) FISSION PRODUCED BY K$^-$ MESONS OF 10.1 GeV/c ON Ag AND Br NUCLEI. Todorovic, Z.; Juric, M. (Inst. of Physics, Belgrade). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The fission of Ag and Br nuclei was studied in nuclear emulsion irradiated by 10.1-GeV/c K$^-$ mesons. Events, which satisfy the basic criterion for fission (range of fragments $5 \leq R \leq 15$ μm and the angle between them $\theta > 90°$) were analyzed kinematically. In this manner the fission events were separated from the cases with ordinary fragments. Emission frequency of the fission events was found. Characteristics of the fission events were compared with those obtained from the interaction of 1.5-GeV/c K$^-$ mesons with Ag and Br. (2 figures) (auth)

5038 (HU-TFT-73-16) SATURATION IN RF SPECTROSCOPY. IV. Transverse Pumping and Haroche's Resonances. Stenholm, S.; Aminoff, C. G. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Apr 1973. 52p. INIS.

The paper shows the problem of a doublet excited state under the influence of an arbitrarily strong RF field and optically pumped by a transverse beam. The solution is obtained as a continued fraction, which is easily evaluated on a computer. Haroche's resonances at even multiples of the radio frequency are investigated and their Bloch-Siegert shifts are determined. The lines are less power broadened than the multi-photon resonances earlier investigated, and they are hence more exactly measurable. In the perturbation limit results derived by Haroche and Cohen-Tannoudji from a quantum theory are regained. Detection at either the dc component or any of the oscillating components is discussed. A generalization of the Cohen-Tannoudji dressed g-factor is found for the Hanle effect. The experimental results for a rotating RF field are discussed, and experiments using a linearly oscillating field performed by Tsukuda, Yabuzaki and Oquwa are compared with the theory. Good agreement is found. (auth)

5039 (JAERI-1228, pp 41-63) CROSS SECTIONS OF THE FISSION PRODUCT NUCLEI. Igarasi, S. I. (Japan Atomic Energy Research Inst., Tokyo); Nakagawa, T.; Kawai, M.; Suehiro, T.; Murata, T. Jul 1973. (In Japanese).

Total cross sections, elastic scattering cross sections, inelastic scattering cross sections and capture cross sections are investigated for some nuclei in the mass region of the fission products. For lack of experimental data of the cross sections for fission products, estimations of the cross sections should be performed by the aid of the nuclear model calculations. In this work, optical potential parameters are looked for by comparing the calculated values and the experimental data of the total cross sections for many nuclei. The potential parameters thus obtained are applied to the calculations of the elastic scattering cross sections and the capture cross sections. Differences between experimental data and the calculated values of the cross sections are about 20% at the most. Results show that the calculated values of the cross sections will not be so different from true values of the cross sections for all nuclei of the fission products. (auth)

5040 (JAERI-1228, pp 102-104) FISSION PRODUCT CROSS SECTIONS IN FAST REACTORS. Otake, I. (Fuji Electric Co. Ltd., Tokyo). Jul 1973. (In Japanese).

Predictions of the burn up characteristics for fast breeder re-

actors require an adequate multi-group cross section set for fission products. The study to produce this cross section set is being conducted by the members of the working group in Reactor Constant Subcommittee, JNDC. Twenty-five- and seventy-group cross section sets of fission products are obtained with the recent available nuclear data files, and the problems in a lumped cross section set are discussed. When the evaluation work of fission product cross section data in JNDC is completed, the update cross section set will be produced. (auth)

5041 (WIS-73-3-Ph) COMPARATIVE ANALYSIS OF NUCLEAR EXCITATIONS BY HIGH-ENERGY ELECTRONS, PROTONS, PIONS, AND ALPHAS. Alexander, Y.; Rinat, A. S. (Weizmann Inst. of Science, Rehovoth (Israel)). 1973. 16p. INIS.

Cross sections for the excitation of resolved nuclear levels by electrons, protons, pions and alphas of highest energy available are analyzed. Reduced cross sections are shown to be approximately proportional to the squared form factors over a relatively wide range of squared momentum transfers t. The proportionality factors for given nucleus and projectile energy are nearly independent of t and the spin of the level, indicating the approximate validity of the DWIA. Ratios of B(El) values for the excitation of different levels in the same nucleus using various projectiles are found to agree. It further appears that the DWIA holds, though to a lesser extent, even for elastic scattering. (5 figures, 1 table) (INIS)

5042 TRANSITION RATES IN ^{97}Tc. Bergman, C.; Svahn, B.; Svensson, L. G.; Baecklin, A.; Lindskog, J. (Univ. of Uppsala). Nucl. Phys.; A223: No. 2, 342-350(1974).

The de-excitation of the 215 keV $^{7}/_{2}^{+}$ and 324 keV $^{5}/_{2}^{+}$ levels in ^{97}Tc, as observed in ^{97}Ru decay, was studied by means of internal conversion electron spectroscopy and the delayed electron-electron coincidence technique. From L-subshell intensity ratios, the E2 content in the 108 and 215 keV transitions were found to be (65 ± 12) and (7 ± 4)%, respectively. The obtained level mean-lives were 0.75 ± 0.09 ns for the 324 keV level and 74 ± 15 ps for the 215 keV level. (auth)

5043 ISOTOPE EFFECTS IN TIN WITH THE LOCAL DENSITY APPROXIMATION. Campi, X. (McMaster Univ., Hamilton, Ont.); Sprung, D. W. L.; Martorell, J. Nucl. Phys.; A223: No. 3, 541-562(1974).

Properties of the even isotopes of tin are calculated using the density dependent effective interaction G-0. Excellent agreement is found for the gross structure of these nuclei. The isotope shift is studied and the factors governing this effect are elucidated. (auth)

5044 WIDTH CORRELATIONS AND INTERMEDIATE STRUCTURE IN THE n-γ SPECTRA OF Au, Sb, I, AND Tb. Jain, A. P.; Cauvin, B.; Lottin, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A223: No. 3, 509-522(1974).

A search for nonstatistical effects in the resonance neutron capture γ-ray spectra of Au, Sb, I and Tb is made through observation of the correlation between neutron and partial radiation widths, and through detection of intermediate structure in the intensity of high energy γ-rays, when plotted as a function of the neutron resonance energy. The integrated intensity method, which is used in the present measurements, is shown to be attractive for a faster mapping of width correlations. A high correlation of 0.96 for Tb and the zero values for Au and I are in agreement with the doorway state hypothesis of Lane. The ^{159}Tb data show nonstatistical behavior, indicating the existence of a narrow intermediate structure with a width of about 40 eV, together with a high value for the correlation coefficient. No evidence for such structure is found in the earlier measurements of similar type on ^{115}In and ^{187}Re when the recently established run statistic is applied to the data. From several experimental facts it is concluded that the neutron capture decay process in Au is in complete agreement with the statistical model, in contrast to the earlier 2p–1h doorway hypothesis for this nucleus. (auth)

5045 THREE-BODY REACTIONS STUDIED WITH BOL. van Dantzig, R.; Blommestijn, G. F. J.; Hermans, W. C. pp 743-746 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Three-body-type reactions can be studied well with the multidetector system BOL. Some general aspects of the system are discussed. The kinematically complete studies made or being made with BOL are summarized. Dalitz plots are shown to illustrate the large-phase-space aspects of the data. (NL)

5046 PROPOSED STUDIES IN FEW NUCLEON RESEARCH WITH THE TRIUMF CYCLOTRON. McMillan, M. pp 751-765 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

TRIUMF is an isochronous, 6 sector, A.V.F., H^- cyclotron under construction in the 1000 acre forest on the University of British Columbia lands. Brief details of the cyclotron, due for completion at the end of 1973, are given. The experimental proposals in the field of physics range over particle, nuclear and solid-state physics. Details are given in this paper some of which concern the few nucleon system. (NL)

5047 INFLUENCE OF ABSORBER THICKNESS ON THE MOESSBAUER QUADRUPOLE SPECTRUM OF ^{121}Sb. Shenoy, G. K.; Friedt, J. M. (CNRS, Strasbourg). Nucl. Instrum. Methods; 116: No. 3, 573-578(1974).

The need for analyzing the Moessbauer quadrupole spectrum of ^{121}Sb with a transmission integral instead of the usual sum-of-Lorentzian function is demonstrated. The latter procedure, which is commonly followed, yields large errors in the hyperfine constants even if the effective absorber thickness is moderate. This procedure also predicts a large Goldanskii–Karyagin effect which in reality does not exist, the intensity deviations being caused by non-zero thickness of the absorbers. (auth)

5048 SPECTROSCOPIC FACTORS OF NEGATIVE-PARITY MULTIPLET STATES IN ODD Sn ISOTOPES. De Barros, S.; Bechara, M. J.; Borello-Lewin, T.; Paar, V. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett.; 49B: No. 2, 113-116(1 Apr 1974).

The spectroscopic factors of the negative-parity multiplet states $7/2_1^-$, $9/2_1^-$, $11/2_1^-$, $13/2_1^-$ and $15/2_1^-$ in odd Sn isotopes are calculated by including leading-order scattering and ground-state correlation processes. It is shown that ground-state correlations play an important role for the spectroscopic factors of the $7/2_1^-$ and $11/2_1^-$ states. The theoretical results are in good agreement with the available experimental data. (auth)

5049 NUCLEAR DATA SHEETS: RECENT REFERENCES. Nucl. Data Sheets; 12: No. 1, 1-142(May 1974).

This volume is a current guide to experimental nuclear physics papers. The information is described by a key word string; for the key words, the user should be able to tell whether the indexed paper contains results relevant to his interests. This volume covers literature received by the Nuclear Data Project or assigned key numbers between September 1 and December 31, 1973. It is divided into three major sections: key numbers and key words, reaction index, and references. (RWR)

5050 EVIDENCE FOR AN ENERGY DEPENDENT FORM FACTOR OF THE α-PARTICLE OPTICAL POTENTIAL. Put, L. W.; Paans, A. M. J. (State Univ., Groningen, Netherlands). Phys. Lett.; 49B: No. 3, 266-268(15 Apr 1974).

Detailed angular distributions for elastic α-particle scattering from ^{90}Zr over a wide angular range were obtained at 40, 59, 80, 100 and 118 MeV. A distinct "break" in the energy dependence of the shape parameters of the optical potential is observed. (auth)

5051 INTERNAL-SOURCE METHOD OF MEASURING ABSOLUTE PAIR-PRODUCTION CROSS SECTIONS. Avignone, F. T. III; Blankenship, S. M. (Univ. of South Carolina, Columbia). Nucl. Instrum. Methods; 116: No. 3, 515-519(1974).

A new technique for measuring absolute pair-production cross sections by low-energy γ rays was developed. The method consists of placing a small spherical radioactive source at the center of a spherical target and observing coincident annihilation γ rays subsequent to creation of $e^- - e^+$ pairs. Monte-Carlo calculations were used to correct the raw data for scattering and absorption of the annihilation γ rays in the target, and also to investigate the importance of pair-creation events following scattering of the incident γ ray. The absolute cross sections for 1.8362-MeV γ rays were measured for tin and lead targets. The resulting cross sections are (420 ± 25) and (1460 ± 90) mb, respectively, which are in excellent agreement with current theory. (4 figures) (auth)

5052 DECAY OF ^{124}Sb. Johnson, J. R.; Mann, K. C. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 52: No. 5, 406-419(1 Mar 1974).

The gamma rays, beta rays, and conversion electrons emitted in the beta decay of ^{124}Sb → ^{124}Te were observed using Ge(Li) and

Si(Li) detectors both singly and in coincidence. The measured energies and intensities of the different transitions involved in this decay together with the coincidence results have allowed one to construct the decay scheme. The spin of most of the states and the parity of all of the states of ^{124}Te populated in this decay were deduced, some of them for the first time, and others as confirmations of previous assignments. One was also able to assign collective parameters to many of these states, in terms of the vibrational model of nuclei, from the reduced branching ratios calculated from the gamma-ray intensities. (auth)

5053 NUCLEAR PROPERTIES: LEVEL SCHEMES, LEVEL DENSITIES. pp 204-248 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Forty-five papers on this topic are presented. Isotopes of the following nuclei were investigated: O, K, Ca, Ti, V, Cr, Mn, Cu, Ge, As, Se, Rb, Kr, Sr, Tc, Ru, In, Sn, Sb, Cd, Ag, La, Ce, Eu, Gd, Lu, Au, Hg, Bi, and Pa. General articles on the density of states in nuclei are also included. (RWR)

5054 NUCLEAR PROPERTIES: ELECTROMAGNETIC MOMENTS. pp 249-305 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P1.

Fifty-seven papers are presented on this topic. Both static and dynamic moments are discussed. Gamma angular correlations, lifetime measurements, level widths, and E1-M2-E3 admixtures are also described. Nuclei from ^{13}C to ^{239}Pu are treated. (RWR)

5055 NUCLEAR PROPERTIES: DISTRIBUTION OF MASS, CHARGE, AND MAGNETISM; NUCLEAR MASSES. pp 306-329 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Twenty-four papers on these topics are presented. Results of experiments on muonic (also kaonic and hadronic) atoms are given. Hyperfine structure, charge and magnetization distributions, nuclear deformations, mass formulas, and studies of neutron-rich nuclides are also discussed. (RWR)

5056 COMPOUND-NUCLEAR REACTIONS, INTERMEDIATE STRUCTURE PRE-EQUILIBRIUM DECAY. pp 499-559 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Sixty-one papers on this topic are presented. The general theme is the kinetics of the compound-nucleus reaction. Second-order and competing processes in various reactions are described. Intermediate structure is discussed in a number of papers. Cross sections and other reaction properties are reported, especially for heavy-ion reactions. Although most of the target nuclei are fairly light, Au and Th were also investigated. (RWR)

5057 ELECTRON SCATTERING. pp 616-631 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc., (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Sixteen papers on this topic are presented. Electron scattering was used to obtain form factors and charge distributions, and to study transitions in the nuclei produced. Target nuclei ranged from ^{9}Be to ^{208}Pb. (RWR)

5058 ALPHA AND BETA DECAY, INTERNAL CONVERSION. pp 687-700 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Fourteen papers on these topics are presented. Subjects discussed include the following: alpha spectroscopy of N = 128 isotones; alpha decay of Fr and Th; beta decay and nuclear structure; high-energy beta decay and delayed proton emission; time-dependent delayed beta spectra from fission fragments; asymmetry in mirror Gamow-Teller β decay; nuclear orientation of ^{58}Fe; decay of ^{125}Ba and ^{127}Ba; polarization and Coriolis force effects on the hindrance factors for allowed transitions to ^{155}Gd; new neutron deficient isotopes of Eu, Sm, and Pm; adjustment of the coupling constants in beta decay; beta-plus/electron capture branching ratios for ^{145}Gd decay; the parity-nonconserving nucleon-nucleon interaction; and penetration effects in M1 transitions in ^{135}La and ^{137}La. (RWR)

5059 INELASTIC ELECTRON SCATTERING. Bishop, G. pp 459-507 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1972).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

After a brief introduction on the advantages and possibilities for high-energy electron scattering, the paper is devoted to the discussion of three principal topics: the precise determination of transition probabilities (particularly with low-energy inelastic scattering), scattering from vibrational and rotational nuclei, and giant multipole resonances and the spatial distribution of effective charges. (28 figures, 1 table, 75 references) (RWR)

5060 GIANT RESONANCES. Walcher, T. pp 509-527 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Until recently the term "giant resonance" was used synonymously for the giant electric dipole resonance (GDR). But relatively simple extensions of theoretical models suggest the possibility of "giant resonances" of multipolarities other than E1. This paper is devoted to experimental evidence regarding these resonances. In recent years the giant dipole resonance has been systematically investigated with monochromatic photon beams from in-flight positron annihilation, and very accurate results have been obtained. The paper focuses on the nuclear continuum, which has been investigated by inelastic scattering of electrons and strongly interacting particles after serious background problems were overcome. It turned out that several modes of excitation other than the GDR could be identified. Besides the well-known giant isovector E1 resonance, a giant isoscalar and an isovector E2 resonance and a giant M1 resonance have been found. These resonances not only provide an important insight into nuclear dynamics but also imply some consequences for other fields of nuclear physics. (12 figures, 3 tables) (RWR)

5061 FORMATION AND NUCLEAR PROPERTIES. Van Tuyl, H. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 49-84 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Promethium is useful because of its unique nuclear properties and its availability from fission products as a by-product of nuclear power generation. The amount of promethium formed in a reactor and the isotopic composition of the promethium depend on reactor parameters, fission yields, neutron cross sections and decay properties of several neodymium and promethium isotopes. Promethium can also be made by irradiation of neodymium. Because of the high neutron-capture cross sections of some neodymium isotopes below 146, several neutrons are captured for each atom of ^{147}Pm produced. The nuclear reactions of neodymium isotopes are of interest in evaluating the amount and quality of promethium produced in this manner. The principal nuclear property of interest for an aged-promethium radioisotopic heat source is the heat generation by ^{147}Pm. An aged source is principally ^{147}Pm, and heat generation by other isotopes is completely negligible. Decay of ^{147}Pm does not yield any high-energy radiation, but the isotopes ^{146}Pm and ^{146m}Pm do contribute an appreciable amount of penetrating gamma radiation. A source of pure ^{147}Pm would be ideal, but adequate promethium-isotopic purity for most purposes can be achieved by controlling the reactor conditions and storage time after reactor discharge. The purpose of this chapter is to summarize and make conveniently available the information dealing with the formation and nuclear properties of promethium. (auth)

5062 ELECTROMAGNETIC PROPERTIES OF THE ($\pi p_{\frac{1}{2}}$,$\nu d_{\frac{5}{2}}$) DOUBLET IN ^{90}Y. Kluge, A.; Kroth, K.; Schroeder, F. J.; Thomas, W.; Toschinski, H.; Guenther, C. (Univ., Bonn). Nucl. Phys., A224: No. 1, 1-12 (1974).

The half-life of the 202.5 keV level in ^{90}Y was remeasured by the $\gamma\gamma$ delayed coincidence technique to 250(7) ps. The g-factor of this state was measured by the integral perturbed angular correlatio' technique using the large field of a superconducting magnet as g = $-0.283(23)$. The intensity ratio fo the 682 keV E5 transition to the 480 keV M4 transition depopulating the 7^+ state in ^{90}Y was determined to be $4.0(8) \times 10^{-3}$. The electromagnetic properties of the low lying states in ^{90}Y are discussed within the framework of the jj coupling shell model. (auth)

5063 DECAYS OF 1.9 MIN ^{119g}Cd AND 2.6 MIN ^{119m}Cd TO ^{119}In. McDonald J.; Fogelberg, B.; Baecklin, A.; Kawase, Y. (Swedish Research Council's Lab., Studsvik). Nucl. Phys., A224: No. 1, 13-33(1974).

The structure of ^{119}In was investigated through a study of the decays of ^{119g,m}Cd by means of γ-ray and conversion electron spectroscopy. Transition probabilities in ^{119}In were deduced from measurements of delayed coincidences. Strongly retarded E1 transitions were observed from two levels which are themselves connected by an E2 transition enhanced by a factor of about 100, possibly indicating the existence of deformed states. A review of the available information on levels of ^{115}In and ^{117}In is given as a prelude to a discussion of the possibility of shape isomerism in ^{119}In. (auth)

5064 SUB-COULOMB, HEAVY ION, ONE-NUCLEON TRANSFER REACTIONS ON THE Z = 40 ISOTOPES AND N = 50 ISOTOPES. Gill, G. A.; Gill, R. D.; Jones, G. A. (Oxford Univ.). Nucl. Phys., A224: No. 1, 140-151(1974).

Sub-Coulomb one-nucleon transfer processes were investigated. These include the transfer reactions induced by ^{13}C ions on ^{90}Zr, ^{88}Sr, ^{92}Mo and proton transfer reactions induced by ^{16}O ions on ^{90,92,94,96}Zr. Angular distributions of all the above reactions were measured and absolute differential cross sections obtained between 90° and 180°. The variation of cross section with Q-value can be experimentally established. Variation of cross section for different fractions of the Coulomb barrier were investigated, and theoretical fits were made using the distorted wave Born approximation. (auth)

5065 γ-RAY DECAYS FROM SINGLE PARTICLE STATES IN ^{91}Zr AND ^{93}Mo. Gill, G. A.; Gill, R. D.; Jones, G. A. (Oxford Univ.). Nucl. Phys., A224: No. 1, 152-163(1974).

Lifetimes were measured in ^{91}Zr and ^{93}Mo by the Doppler shift attenuation method through the ^{90}Zr(^{13}C,^{12}C)^{91}Zr and the ^{92}Mo (^{13}C,^{12}C)^{93}Mo reactions. Gamma rays were observed in coincidence with the back scattered particles and the reactions took place at sub-Coulomb energies. The lifetimes measured in ^{91}Zr are τ(1205) = 250^{+40}_{-40} fs, τ(1467) = 280^{+40}_{-40} fs, τ(2042) < 30 fs, τ(2558) = 180^{+20}_{-20} fs. The lifetimes measured in ^{93}Mo are τ(1361) = 170^{+20}_{-20} fs, τ(1494) = 60 ± 40 fs, τ(1697) = 440^{+80}_{-80} fs, τ(2705) = 160^{+20}_{-20} fs. These results are compared with the expectations of the shell model and the $3s_{\frac{1}{2}} \rightarrow 2d_{\frac{5}{2}}$ E2 transition is shown to be very enhanced. (auth)

5066 TOTAL (n,2n) CROSS SECTIONS AND ISOMERIC CROSS SECTION RATIOS AT 14.7 MeV IN THE REGION OF RARE EARTHS. Qaim, S. M. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A224: No. 2, 319-330(1974).

Total cross sections for (n,2n) reactions at 14.7 ± 0.3 MeV on twenty-nine stable nuclides of the elements cerium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and hafnium were measured by the activation technique using Ge(Li) detector γ-ray spectroscopy. Isomeric (n,2n) cross section ratios were determined for the isomeric pairs ^{137m,g}Ce, ^{139m,g}Ce, ^{141m,g}Nd, ^{143m,g}Sm, ^{150m,g}Eu, ^{153m_1,g}Eu, ^{152m_1,g}Eu, ^{158m,g}Tb, ^{164m,g}Ho and ^{174m,g}Lu. A comparison of the experimental cross section values with theoretical estimates based on the statistical model confirms that the (n,2n) reaction at this energy, in the rare-earth region proceeds mainly via compound nucleus formation and accounts for > 80% of the total inelastic cross section. (auth)

5067 LIFETIME AND MAGNETIC MOMENT OF THE $\frac{9}{2}^-$ ANOMALOUS COUPLING STATE IN ^{127}Te. Soares, J. C.; Herzog, P.; Huebel, H. (Univ., Bonn). Nucl. Phys.; A224: No. 2, 358-366(1974).

The half-life of the $\frac{9}{2}^-$ state at 341 keV in ^{127}Te was remeasured by the delayed coincidence technique with the result $T_{\frac{1}{2}}$ = 411 ± 17 psec. The magnetic moment of this state was determined from an integral perturbed directional correlation measurement using the magnetic hyperfine field for Te in an iron host lattice. The g-factor of the 341 keV state, g = −0.214 ± 0.014 was derived. This value and the reduced transition probabilities for the $\frac{9}{2}^- \rightarrow \frac{11}{2}^-$ transition support the interpretation of the 341 keV $\frac{9}{2}^-$ level as an "anomalous coupling state." (auth)

5068 BETA DECAY STUDIES IN THE VICINITY OF ^{132}Sn EXCITED STATES IN ^{130}Sb, ^{130}Te, AND ^{132}Te. Kerek, A.; Carle, P.; Borg, S. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A224: No. 2, 367-395(1974).

Using the OSIRIS on-line isotope separator facility, the decays of ^{130}Sn and ^{130,132}Sb were studied. On the basis of singles γ and γ−γ coincidence Ge(Li) spectra and conversion electron Si(Li) measurements, level schemes for ^{130}Sb, ^{130}Te and ^{132}Te were constructed. The corresponding half-lives were measured using multiscaling technique. The 3.8 min ground state of ^{130}Sn populates only positive parity states in the $\pi\nu^{-3}$ nucleus ^{130}Sb: the energetically lowest 5^+ state with the $(\pi 1g_{\frac{7}{2}}, \nu 2d_{\frac{5}{2}})$ configuration assignment; the $T_{\frac{1}{2}}$ = 3.6 ± 0.3 ns 4^+ state at 70.0 keV; the 2^+ state at 262.5 keV; the $(0,1)^+$ state at 697.2 keV; the 3^+ state at 813.1 keV; and the 1^+ state at 1042.3 keV excitation energy. A 1.7 min isomeric state in ^{130}Sn, with the tentative spin assignment (7^-), populates several odd parity levels in ^{130}Sb. These arise from the $(\pi 1g_{\frac{7}{2}}, \nu 1h_{\frac{11}{2}}{}^{-1})$ and/or $(\pi 2d_{\frac{5}{2}}, \nu 1h_{\frac{11}{2}}{}^{-1})$ configurations and are located 84.7 keV (6^-), 144.9 keV (7^-), 688.5 keV and 1044.0 keV above the 40 min 8^- β-decaying state. No transitions between odd and even parity states were observed. The most important excited states in ^{130}Te found in the β^- decay of the 6.6 min ^{130}Sb 5^+ state are: 839.4 keV, 2^+; 1632.8 keV, 4^+; 1815.1 keV, 6^+; 2100.8 keV, 5^-. Levels in the $\pi^2\nu^{-2}$ nucleus ^{132}Te were observed in the β^- decays of the 2.8 min ^{132}Sb (4^+) and the 4.2 min ^{132}Sb (8^-) states. Unique spin and parity assignments were given to the following states: 973.9 keV, 2^+; 1670.7 keV, 4^+; 1774.1 keV, 6^+; 1924.7 keV, 7^-; 2053.0 keV, 5^-. (auth)

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Refer also to abstracts 3296, 3928, 4937, 4966, 4982, 4984, 5007, 5016, 5020, 5022, 5044, 5049, 5053−5055, 5066, 5114, 5123, 5186, 5188, and 5195.

5069 (ISN-7333) EFFECTIVE MATRIX ELEMENTS IN DEFORMED NUCLEI. Piepenbring, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1973. 52p. (CONF-730997-1). Dep. NTIS (US Sales Only) $5.75.

From sixth summer school on nuclear physics; Mikolajki, Poland (3 Sep 1973).

A coherent description is given of the properties of odd-mass number deformed nuclei (Coriolis coupling, residual interactions) in the framework of the unified model. No hypotheses are made for the intrinsic part of the Hamiltonian. Its matrix elements are considered to be essentially adjustable parameters, as is the case for other intrinsic operators, the values obtained for these parameters being the effective matrix elements. The problem to be resolved is that of effecting a nonlinear fitting using the least squares method. (FR)

5070 (NP-19997) INTERNAL CONVERSION PROCESSES AND RADIATION STRENGTHS IN THE RADIOACTIVE DECAY OF ATOMIC NUCLEI. Holmberg, L. (Stockholm Univ. (Sweden)). 1973. 46p. Dep. NTIS (US Sales Only) $5.50.

Thesis.

Measurements of lifetimes of excited nuclear states are described. The life-time measurements are part of a study where also intensity and directional correlation methods are applied. The radiation strengths deduced are used for a discussion in qualitative terms of the structure of the nuclear states; the degree of coherence in the states is investigated. Transitions in the following nuclei are reported: ^{177}Hf (113 keV M1 + E2 transition); ^{115}In(E2); ^{136}Ba(El); ^{146}Eu(M1); and ^{221}Fr(E2). Internal conversion is discussed in terms of E2 transitions, E1 transitions, M1 + E2 mixtures, and E0 + M1 + E2 mixtures. Methods applied in this work and current developments on electron-gamma directional correlation are discussed. (BRH)

5071 LIFETIMES IN THE GROUND-STATE BAND OF ^{184}Hg. Rud, N. (University of Aarhus, Aarhus, Denmark); Ward, D.; Andrews, H.R.; Graham, R.L.; Geiger, J.S. Geiger (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada K0J 1J0). Phys. Rev. Lett. 31: No. 23, 1421-1423 (3 Dec 1973).

The ground-band level sequence in ^{184}Hg has been identified to spin 10^+ and possibly to 14^+. Lifetimes for the 2^+, 4^+, and 6^+ states have been measured. The results imply the onset of a permanent deformation above the 2^+ level. (auth)

5072 ENHANCED-SENSITIVITY γ-γ CORRELATION TEST OF TIME-REVERSAL INVARIANCE IN ^{180}Hf. Murdoch, B.T.; Olsen, C.E.; Steyert, W.A. (Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico 87544); Krane, K.S. Phys. Rev. Lett. 31: No. 25, 1514-1517 (17 Dec 1973).

Directional correlations of the strongly hindered 501-keV γ ray with subsequent 332- and 215-keV γ rays from polarized ^{180m}Hf showed an average time-reversal-invariance-violating asymmetry of $(2.8 \pm 5.1) \times 10^{-4}$, indicating no substantial effect. The phase angle between the 501-keV E3 and M2 components was $\sin\eta = +0.048 \pm 0.087$ and the out-of-phase components of the multipole matrix elements were,

respectively, $(+1.1\pm2.1)\times10^{-6}$ and $(-2.1\pm3.8)\times10^{-9}$ Weisskopf units. (auth)

5073 NEW K=0 BANDS AND TWO-PHONON GAMMA VIBRATIONS IN ^{188}Os AND ^{190}Os. Sharma, H.L.; Hintz, N.M. (J. H. Williams Laboratory, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. Lett. 31: No. 25, 1517-1520 (17 Dec 1973).

The level structure of ^{188}Os and ^{190}Os has been investigated by the (p,t) reaction at 19.0-MeV proton energy. New 0^+ states were seen at 1480 and 1705 keV in ^{188}Os and at 1551 and 1734 keV in ^{190}Os. Additional evidence is presented for describing the lowest excited K=0 and K=4 bands as two-phonon γ vibrations. (auth)

5074 ROTATIONAL BANDS $\frac{1}{2}^+[411]$ AND $\frac{1}{2}^-[541]$ IN ^{175}Lu. Winter, G.; Andrejtscheff, W.; Funke, L.; Manfrass, P.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A223: No. 2, 320-332(1974).

In a study of the γ-radiation emitted in the reaction ^{176}Yb(p,2n) excited states of the nucleus ^{175}Lu up to spin $I = 13/2$ were investigated. The main results concern the rotational bands $\frac{1}{2}^+[411]$ and $\frac{1}{2}^-[541]$ with the corresponding band heads found at 626.60 and 370.88 keV, respectively. The half-life of the $\frac{1}{2}^+[411]$ level was determined to be $T_{\frac{1}{2}} = 10.7 \pm 0.5$ ns. Furthermore, the band heads $\frac{3}{2}^-[532]$ and $\frac{3}{2}^+[411]$ are proposed at energies of 999.0 and 1150.8 keV, respectively. Experimental E1 transition probabilities between both $K = \frac{1}{2}$ bands are compared with calculations including the Coriolis and pairing effects, as well as theoretically deduced quadrupole deformation parameters. (auth)

5075 COULOMB EXCITATION IN ^{180}Hf. Varnell, L. (Vanderbilt Univ., Nashville); Hamilton, J. H.; Robinson, R. L. Nucl. Phys.; A223: No. 3, 442-444(1974).

Coulomb excitation studies were performed to measure transition probabilities of collective quadrupole vibrational states in ^{180}Hf. The I = 2 level of the $K^\pi = 2^+$ collective γ-band is established at 1200.5 keV with $B(E2)_{exc} = (11.0 \pm 1.1) \times 10^{-50}\ e^2 \cdot cm^4$ (3.6 ± 0.4 s.p.u.). The angular distribution of the de-exciting γ-rays from this level yields $\delta = 9.6^{+13}_{-3.8}$ or, less likely, 0.7 ± 0.2 for the 1107.2 keV $2^+_\gamma \rightarrow 2^+_g$ transition. The $B(E2)_{exc}$ for any $K^\pi I = 0^+2$ state or other 2^+ states up to 1500 keV is less than $5 \times 10^{-51}\ e^2 \cdot cm^4$ (<0.2 s.p.u.). (auth)

5076 PAIRING AND HEXADECAPOLE FIELDS IN DEFORMED SAMARIUM ISOTOPES AS PROBED BY TWO-NUCLEON TRANSFER REACTIONS. Soerensen, B. (Niels Bohr Inst., Copenhagen). Phys. Lett.; 49B: No. 2, 109-112(1 Apr 1974).

The relation between static pairing or hexadecapole deformation and differential cross section for two-nucleon transfer reactions is discussed. A coupled channels calculation of the reaction ^{154}Sm(t,p)^{156}Sm shows that the 2^+ state is most sensitive to the magnitude of pairing and hexadecapole deformations, contrary to the simple expectation that the 0^+ and 4^+ state, respectively, would be the most sensitive to the two fields. (auth)

5077 TWIN BACKBENDING IN ^{156}Dy. Lieder, R. M. (Kernforschungsanlage, Juelich, Ger.); Beuscher, H.; Davidson, W. F.; Neskakis, A.; Mayer-Boericke, C.; El Masri, Y.; Monseu, P.; Steyaert, J.; Vervier, J. Phys. Lett.; 49B: No. 2, 161-164(1 Apr 1974).

The ground-state and β-bands in ^{156}Dy have been definitely established up to 20^+ using the (α,8n) and (p,4n) reactions. They cross at 16^+. Two backbendings were observed and attributed to the crossing of a third band with these two bands. (auth)

5078 EFFECT OF HEXADECAPOLE DEFORMATIONS ON $1i_{13/2}$ ORBITS AND PICKUP CROSS SECTIONS IN THE TUNGSTEN NUCLEI. Casten, R. F. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 49B: No. 3, 258-260(15 Apr 1974).

Previous (d,t) and (τ,α) cross sections to $13/2^+$ states in odd-mass tungsten nuclei have been interpreted in terms of moderate hexadecapole deformations ($\epsilon_4 \approx 0.06$) while a recent Coulomb excitation measurement has suggested a much larger value for ^{183}W. The pickup spectra were calculated and it was shown that in fact the data can be successfully interpreted with a wide range of ϵ_4 values from $\approx$0.06 to $\approx$0.16. (auth)

5079 ISOMERIC LEVELS IN DOUBLY-EVEN HAFNIUM NUCLIDES. Rezanka, I.; Ryde, H.; Hultberg, S. (Forskningsinstitutet foer Atomfysik, Stockholm). Phys. Scr.; 8: No. 6, 239-243(Dec 1973).

The level structure of ^{172,174,176,178}Hf is studied by means of (α,xn) reactions. The ground-state rotational bands are followed up to spin 16^+ in ^{172}Hf, up to spin 14^+ in ^{174,176}Hf, but only up to spin 8^+ in ^{178}Hf. In addition, two-quasiparticle isomeric states are observed in these nuclei: $K = 6^+$ states in ^{172,174,176}Hf and $K = 8^-$ states in ^{176,178,180}Hf. In several cases the rotational bands built on these states are observed. The variation of the moment of inertia with the angular velocity and the population of the intrinsic states in the compound nuclear reaction are discussed. (auth)

5080 RECENT RESULTS ON THE FUSION REACTIONS BETWEEN VERY HEAVY IONS AND NUCLEI. Lefort, M. (Institut Physique Nucleaire, Orsay, France). J. Phys., A (London); 7: No. 1, 107-119(1 Jan 1974).

Results are given for measurements of complete fusion cross sections in ^{40}Ar- and ^{84}Kr-induced reactions on medium and heavy targets. After complete fusion, composite nuclei decay by particle and gamma-ray emission and also, in large proportions, by binary fission. Cross sections were measured on the residual nuclei and on binary fissions following full momentum transfer, i.e., fissions issued from complete fusion. In the case of Ar ions, the fusion cross section is still a large part of the total reaction cross section, and the restriction due to high angular momentum is not severe. It was found that the ratio σ_{CF}/σ_r increases with the bombarding energy. If one assumes that σ_{CF} corresponds to the summation of partial waves up to a critical value of the angular momentum, l_{cr}, very large values of l_{cr} were obtained (up to 140). With krypton projectiles there is also a large proportion of complete fusion if the compound nucleus is in the intermediate mass region. On the other hand, with targets of bismuth and uranium a very small cross section was observed for fission events following a fusion process. An intermediate situation was found in the case of holmium and tungsten targets. Most of the reaction cross section goes into incomplete fusion channels, with a large loss of kinetic energy. A discussion is given on the dynamical aspects of the collision between two heavy nuclei. (3 figures, 5 tables) (auth)

5081 NUCLEAR PROPERTIES: HIGH SPIN STATES. pp 164-203 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Forty papers on this topic are presented. Experimental and theoretical aspects of high-spin states of nuclei from ^{16}O to ^{192}Hg are discussed. The back-bending phenomenon is described for a number of nuclei. (RWR)

5082 INELASTIC SCATTERING, COULOMB EXCITATION, CHARGE EXCHANGE. pp 373-409 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Thirty-seven papers on these topics are presented. The bulk of the papers are concerned with inelastic scattering and deuteron breakup; both light and heavy ions were used as projectiles. The charge-exchange reactions studied include those initiated by both mass-1 and mass-3 beams. Virtual Coulomb excitation, Coulomb–nuclear interference, coupled-channel calculations with Coulomb excitation, tests of shell-model wave functions, and effective interactions are also discussed. (RWR)

5083 HIGH-SPIN ROTATIONAL STATES AND NUCLEAR STRUCTURE. Szymanski, Z. pp 401-436 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

Experiments on the high angular momentum states of nuclei open up the possibility of studying the properties of the nuclear system in an extreme condition of fast rotation. The properties of nuclear spectra and nuclear structure which arise with increasing angular momentum are reviewed. At a certain value of angular momentum (about I = 14 in rare earth nuclei) a violent change in nuclear structure may occur which results in a rapid increase of the moment of inertia and the local decrease of the angular velocity of the collective rotation. The discussion is divided into three parts, corresponding to the region below the transition, the transition region, and the region above the transition. (In rare earth nuclei this division corresponds to roughly $I \lesssim 10$, $10 < I < 20$, and $I \gtrsim 20$, respectively.) The discussion is restricted to the yrast line. (12 figures, 137 references) (RWR)

5084 HEAVY ION FUSION EXPERIMENTS. Blann, M. pp 657-680 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The paper begins by defining the fusion cross section and de-

scribing what can be learned about physics from its investigation. Experimental techniques to measure the fusion cross section are mentioned, and a summary of published fusion and evaporation residue cross sections is shown. The concept of the fusion barrier for zero angular momentum is then discussed, and some experimental results to determine fusion barrier heights and radii are placed in the perspective of theory. Fusion reactions above the barrier are then considered with respect to limits imposed by high angular momentum or by Z. Theoretical aspects (potentials for two-body contact configurations, dynamic effects, survival of compound nuclei) are examined first, and these are followed by experimental results and inferences. (15 figures) (RWR)

5085 NUCLEAR LEVEL STRUCTURE INVESTIGATIONS IN EVEN-EVEN TUNGSTEN, OSMIUM, AND PLATINUM NUCLEI BY RADIOACTIVE DECAY AND IN-BEAM GAMMA-RAY SPECTROSCOPY. Yates, S. W. Lafayette, IN; Purdue Univ. (1973). 302p. University Microfilms Order No. 74-5070.

Thesis (Ph.D.).

The level structures of ^{184}W and ^{190}Os were investigated by radioactive decay methods, and ^{190}Pt, ^{192}Pt, and ^{194}Pt were studied by in-beam γ-ray spectroscopy techniques. All of the in-beam and decay studies included γ-ray singles and γ-γ coincidence analysis, and γ-ray anisotropy measurements were made in the in-beam reactions. Interpretations of the level structures are provided in terms of the appropriate nuclear models. The decay of 8.7 h ^{184}Ta into ^{184}W was studied using radioactive sources prepared by the (d,α) reaction, and a ^{184}W level scheme which accommodates greater than 99% of the decay intensity was established. Levels in ^{184}W at 1699 and 1746 keV which de-excite predominantly to the 8.3 μs isomeric level at 1285 keV are most strongly populated in the β^- decay. The 1699 keV level also de-excites to members of a $\frac{1}{2}^-[510]\nu$-$\frac{1}{2}^-[503]\nu K^\pi = 3^+$ band based at 1425 keV. New information about the properties of the γ-vibrational and K = 2 octupole bands in ^{184}W is presented and possible configurations of the levels populated directly in the β^- decay are discussed. The configuration $\frac{7}{2}^+[404]\pi$-$\frac{3}{2}^-[512]\nu K^\pi = 5^-$ is indicated for the ^{184}Ta ground state. The levels of ^{190}Os populated in the decays of 3.3 h ^{190m}Re, 3.1 min ^{190}Re and ^{190}Ir were examined. Radioactive ^{190m}Re sources were prepared by the (d,α) reaction and ^{190}Ir was produced by the (d,2n) reaction. Sources of the ^{190}Re isomers were also produced by the (n,p) reaction. The existence of the 3.3 h ^{190}Re isomer was confirmed and the first detailed study of this decay was carried out. This isomer was observed to decay ~49% by isomeric transitions and ~51% by β^- decay to levels in ^{190}Os with spins $\geq$5, and the $\frac{1}{2}^+[402]\pi$-$\frac{1}{2}^-[503]\nu$ $K^\pi = 6^-$ configuration is proposed for this state. In a reinvestigation of the 12 d ^{190}Ir decay, a virtually complete decay scheme was established and discrepancies between the spin-parity values assigned to several ^{190}Os levels by earlier workers resolved. The K = 2 γ-vibrational band in ^{190}Os was extended to the 6^+ member while the first three members of the K = 3 octupole and K = 4 two-phonon γ-vibrational bands were established. From the observed fast β^- decay characteristics of ^{190}Re it was proposed that the allowed unhindered transition $\frac{9}{2}^-[505]\nu$-$\frac{5}{2}^+[402]\pi$ $I^\pi K = 2^-2 \rightarrow 11/2^-[505]\nu$-$\frac{5}{2}^+[402]\pi$ $I^\pi K = 3^-3$ is involved in accord with a recent microscopic description of K = 3 octupole excitations in the osmium region. Investigations of the low lying excitations in the ^{190}Pt, ^{192}Pt, and ^{194}Pt nuclei were performed using the $(p,2n\gamma)$ and $(\alpha,2n\gamma)$ reactions on enriched iridium and osmium targets. A 5^-, 7^-, 9^- sequence of levels which play a major role in the yrast cascades were identified in ^{190}Pt and ^{192}Pt in analogy with excitations previously identified in the mercury nuclei and the heavier platinum isotopes. Indications are that these high spin negative parity states arise from various couplings of the parity-unique $i_{13/2}$ neutron with $f_{5/2}$, $p_{3/2}$, or $p_{1/2}$ neutrons. The ground state bands were observed to 8^+ in ^{192}Pt and ^{194}Pt and 10^+ in ^{190}Pt in the $(\alpha,2n\gamma)$ reactions, and many new levels in addition to levels previously identified in decay work were established. (Diss. Abstr. Int., B)

5086 SEMI-MICROSCOPIC DESCRIPTION OF THE DENSITY OF EXCITED STATES IN DEFORMED NUCLEI. Malov, L. A.; Soloviev, V. G.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A224: No. 2, 396-410(1974).

A semi-microscopic method of calculating the density of states of intermediate and high excitation energies in deformed nuclei is suggested. The method is used to calculate the densities of the states of 31 nuclei of the rare-earth and transuranium region at the neutron binding energy. The results of calculations are in satisfactory agreement with experiment. The difference in the density of states of doubly even and odd-A nuclei is correctly described. The effect of nuclear vibrations on the density is studied. The dependence of the density on the excitation energy and the quantum number K is investigated. (auth)

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Refer also to abstracts 3296, 3378, 4109, 4936, 4969, 4972, 4982, 4984, 4996, 4997, 5007, 5020, 5023, 5033, 5044, 5049, 5051, 5053, 5054, 5057, 5059, 5060, 5073, 5080, 5085, 5094, 5122, 5123, and 5356.

5087 (CONF-720724-P2, pp 59-62) TERNARY FISSION INDUCED BY PROTONS OF 12.2 GeV ON U, Th, Pb, Au, Pt, Sn AND Ag NUCLEI. Antanasijevic, R.; Todorovic, Z.; Juric, M. (Inst. of Physics, Belgrade). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Ternary fission induced by 12.2-GeV protons was analyzed in solid state track detectors (makrofol) as a function of the atomic mass of the target nuclei. Basic characteristics of ternary fission are discussed. The cross-sections for ternary fission of some elements that were analyzed are given. (auth)

5088 (CONF-720724-P2, pp 122-124) HEAVY FRAGMENT PRODUCTION THROUGH THE INTERACTION OF HIGH ENERGY NITROGEN IONS WITH GOLD NUCLEI. Roberts, J. H. (Macalester Coll., St. Paul); Behkami, A. N.; Tamai, E. J. 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

Two stacks of 50 Lexan sheets, 250 μm thick, with a number of Au foils interspersed were exposed to about 10^7 N ions of 2.05 GeV/nucleon. A similar stack, but containing 330 sheets of Lexan, was exposed to N^{+7} ions of 250 MeV/nucleon. Preliminary results indicate that the momentum transferred to the heavy fragments is especially small at a beam energy of 2.05 GeV/nucleon, with some increase in momentum transfer at the lower energies in the stack. The gold (~2 mg/cm^2) was probably too thick to make probable the observation of three-pronged events in the Lexan—only one doubtful case was found. (RWR)

5089 (INIS-mf-1222) EXCITED LEVELS IN ^{208}Tl. da Silva, A. G.; Auler, L. T.; de Almeida, G. L.; Toepke, R. H. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). [nd]. 17p. INIS.

The energies and relative intensities of gamma-rays from excited levels of ^{208}Tl populated in the alpha decay of ^{212}Bi have been measured using coincidence techniques. These values are consistent with those obtained from alpha-particle spectroscopy data. Low-intensity gamma-ray transitions of 493 and 620 keV have been found which had not been detected before. An upper limit of .004% has been set for the intensities of possible transitions of 124, 145, 165 and 295 keV reported earlier. K-shell internal conversion coefficients were obtained. (INIS)

5090 (ITEF-965) DETERMINATION OF CROSS SECTION AND VALUE OF ANGULAR ANISOTROPY OF FISSION FOR THE NUCLEI ^{238}U, ^{209}Bi, ^{208}Pb, ^{207}Pb, ^{206}Pb, AND ^{197}Au IRRADIATED BY PROTONS WITH ENERGIES FROM 70 TO 200 MeV. Lomanov, M. F.; Shimchuk, G. G.; Bychenkov, V. S.; Obukhov, A. I.; Perfilov, N. A.; Shigaev, O. E.; Yakovlev, R. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 15p. (In Russian). INIS.

Nuclear fission cross sections and the value of the angular anisotropy of fission were determined for uranium, bismuth, lead isotopes, and gold irradiated by protons with energies of 70, 100, 150, and 200 MeV. Solid-state track detectors (glass) were used as detectors of the fission fragments. It was found that the value of the anisotropy in the angular distribution of the fission fragments of the nuclei cited decreases with increase of the proton energy from 70 to 200 MeV. (4 figures, 1 table) (tr-auth)

5091 (JAERI-1228, pp 150-156) RADIATIVE CAPTURE OF 14 MeV NEUTRONS BY NUCLEI. Kitazawa, H. (Tokyo Inst. of Tech.). Jul 1973. (In Japanese).

The radiative capture cross sections for 14 MeV neutrons of ^{208}Pb and ^{48}Ca are theoretically calculated on the basis of the direct-semi-direct capture models which have been independently developed by Brown, Clement et al. and Lushnikov et al. It seems that the profiles of the capture γ-ray spectrum for the transitions to low-lying states are well interpreted by these models. As far as the absolute magnitude of the cross section is concerned, however, it appears that the calculated cross sections for doubly magic nuclei, in the same manner as the cases for deformed nuclei, are considerably smaller than those measured by activation method. (auth)

5092 EXACT FINITE-RANGE DISTORTED-WAVE BORN-APPROXIMATION CALCULATION FOR THE REACTIONS $^{208}Pb(^{16}O, ^{15}N)^{209}Bi$ AND $^{88}Sr(^{16}O, ^{15}N)^{89}Y$. Tamura, T.; Low, K.S. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 31: No. 22, 1356-1358 (26 Nov 1973).

We develop a straightforward, fast approach to exact finite-range distorted-wave Born-approximation calculations, and apply it to the analyses of the reactions $^{208}Pb(^{16}O, ^{15}N)-^{209}Bi$ and $^{88}Sr(^{16}O, ^{15}N)^{89}Y$. (auth)

5093 β-DECAY $^{210}Bi(RaE) \rightarrow {}^{210}Po(RaF)$. Behrens, H.; Szybisz, L. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys.; A223: No. 2, 268-284(1974).

It was the aim of the present work to extract nuclear wave functions directly from experimental data of β-transitions. As a favorable example the 1^- (1.153 MeV β^-)0^+ β-transition of $^{210}Bi(RaE)$ was studied. The results obtained are compared with theoretical wave functions and good quantitative agreement, especially for the ground state of the daughter nucleus ^{210}Po, was found. It is explicitly demonstrated how, in this case, the higher order terms of the transition matrix elements contribute. The results for the matrix element ratios u and Λ are discussed. In particular it is shown that it is not possible to test CVC theory by examining Λ. (auth)

5094 RELATIVE INTENSITY AND INTERNAL CONVERSION COEFFICIENT MEASUREMENTS IN THE DECAYS OF ^{51}Cr, ^{137}Cs, ^{192}Ir, AND ^{207}Bi. Willett, J.B.; Emery, G.T. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Ann. Phys. (N.Y.) 78: No. 2, 496-517 (June 1973).

An "internal conversion coefficient spectrometer" utilizing Ge(Li) and Si(Li) detectors has been used to make precision measurements of relative gamma-ray intensities for transitions following the decay of ^{192}Ir and ^{207}Bi, relative internal conversion line intensities for some transitions from ^{192}Ir, and conversion coefficients for some transitions from the decays of ^{51}Cr, ^{137}Cs, and ^{192}Ir. Limits and values are given for E2/M1 mixing ratios and penetration effects for the 320.1-keV transition in ^{51}V, the 484.5-keV transition in ^{192}Os, and the 604.4-keV transition in ^{192}Pt. The consequences of the results for nuclear structure are discussed. (auth)

5095 MICROSCOPIC DESCRIPTION OF MUONIC BISMUTH. Herold, D. (Technische Hochschule, Darmstadt, Ger.); Tomselli, M.; Gruenbaum, L. Phys. Lett.; 49B: No. 3, 246-248(15 Apr 1974).

The resonance process in muonic bismuth has been calculated using a microscopic particle-core coupling model. The results are in good agreement with available experimental data. (auth)

5096 INTERNAL CONVERSION MEASUREMENTS IN ^{207}Pb USING A COMBINATION MAGNETIC-Si(Li) SPECTROMETER. Avignone, F. T. III. (Univ. of South Carolina, Columbia). Nucl. Instrum. Methods; 116: No. 3, 521-524(1974).

The relative intensities of fifteen internal conversion lines associated with the 5 electromagnetic transitions in ^{207}Pb, following the decay of ^{207}Bi, were measured. The following internal conversion coefficients were determined: $\alpha_K(897) = (1.81 \pm 0.25) \times 10^{-2}$, $\alpha_K(1063) = (9.43 \pm 0.47) \times 10^{-2}$, $\alpha_K(1442) = (2.7 \pm 0.4) \times 10^{-2}$, and $\alpha_K(1770) = (3.0 \pm 0.5) \times 10^{-3}$. The results are consistent with prior multipolarity assignments of M1 for the 897.3-keV transition and E2 for the 1442.0-keV transition, and are also consistent with earlier assignments of M1 for the 1769.7-keV transition. The value of $\alpha_K(1063)$ is several percent lower than earlier reported values. The power of this technique for investigating very weak lines is clearly demonstrated by the results obtained for the 897.3- and 1442.0-keV transitions. (2 figures, 2 tables) (auth)

5097 PANALYZATION AS A PROBE OF THE MECHANISM OF DEUTERON DISINTEGRATION. McKee, J. S. C.; Blyth, C. O.; Berovic, N.; Pope, C. pp 991-993 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Panalyzation is the name given to the process by which a neutron appearing from the disintegration of a vector polarized deuteron in the Coulomb field of a heavy nucleus has its polarization analyzed by Schwinger scattering from the same nucleus. This process can only occur unambiguously when the Coulomb breakup radius is substantially greater than the nuclear radius of the scattering. The measurement of cross section asymmetry for these neutrons emitted at small angles from the second scattering process could be a useful probe of the nature of the primary decay of the deuteron. For an M_1 decay no asymmetry would presumably be observed. For the E_1 decay, the asymmetry should reflect directly the electric dipole contribution to the disintegration. An experiment is described which attempts, in a complete experiment, the unambiguous selection of neutrons created from the Coulomb disintegration of the deuteron and measures the asymmetry in the differential cross section for scattering of such neutrons when emitted at small angles from the second interaction process. The work described was performed on the Birmingham University Radial Ridge Cyclotron which gives 12.3 MeV vector polarized deuterons with "spin up" and "spin down" orientation rapidly alternated in the ion source. (auth)

5098 PERIPHERAL BREAK-UP OF ^3He ON ^{197}Au. Hermsen, W.; van Dantzig, R.; Joosten, J. A.; Wielinga, B. J.; Wapstra, A. H.; Ijpenberg, A. D.; Slaus, I. pp 968-971 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Evidence is given for predominant correlation effects for p-d pairs resulting from ^3He particles which are broken up in peripheral nuclear collisions. The experiments were performed with the BOL 64-detector system at IKO. It is concluded that these preliminary data indicate that nuclear break-up of ^3He—on a heavy nucleus—yields strongly correlated p-d pairs, preferentially leaving the recoil nucleus unexcited, and that this effect can be related to low energy quartet p-d scattering, as well as to a peripheral dissociation mechanism. (auth)

5099 DISTRIBUTION OF CHARGE AND MAGNETISM IN NUCLEI. Engfer, R. pp 437-458 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Although the determination of nuclear charge distributions is an old problem, there has been considerable activity in the study of nuclear sizes in recent years. Much attention was directed to the model-independent determination of charge distributions from elastic electron scattering and muonic atom data, the calculation of error bars at different radii of a charge distribution, present limitations of accuracy due to nuclear polarization and vacuum polarization, and possible differences in elastic electron scattering and muonic atom results. Related to these problems are the interpretation of a large number of muonic isomer shifts measuring the difference of charge distribution in the ground and excited state and the distribution of magnetization densities deduced from 180° elastic electron scattering and the magnetic hyperfine splitting of muonic x rays and nuclear gamma rays in a muonic atom (Bohr-Weisskopf effect). (9 figures, 1 table) (BWR)

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Refer also to abstracts 3253, 3268, 3780, 4815, 4836, 4892, 5049, 5054, 5056, 5058, 5059, 5070, 5080, 5082, 5086, 5087, 5090, 5160, 5189, and 5356.

5100 (BARC/I-62) DETERMINATION OF PLUTONIUM-239 FISSION YIELDS USING A Ge(Li) DETECTOR. Jain, H. C.; Rengan, K.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 15p. INIS.

Results of yield measurements in the thermal neutron fission of ^{239}Pu using a Ge(Li) detector are reported. The Ge(Li) system, target preparation, irradiation and counting techniques are described. The analysis of the gamma-ray spectra is done by an analysis of the photopeaks. Details of selected photopeaks of nuclides determined together with interference, irradiation and cooling times necessary are summarized. A list of fission product nuclides of interest together with their half-lives, gamma-ray energies and abundances is presented. Fission yields for various nuclides are presented. The results are compared with radiochemical and mass spectrometric data available from literature. It is concluded that the Ge(Li) detector is very useful for the determination of fission yields and forms a complementary tool to the radiochemical methods. (10 figures) (INIS)

5101 (BARC/I-135, pp 55-61) FISSION YIELD MEASUREMENTS IN THE THERMAL NEUTRON FISSION OF ^{239}Pu. Jain, H. C.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). 1971.

The fission yield of ^{99}Mo in the thermal neutron fission of ^{239}Pu has been investigated in detail. The number of fissions has been

calculated by irradiating accurately known and isotopically analyzed amounts of ^{239}Pu and ^{235}U and monitoring the neutron flux using the ^{59}Co(n,γ)^{60}Co reaction. ^{99}Mo fission yield in ^{239}Pu fission has been calculated as 6.79 ± 0.15 on comparison basis by taking ^{99}Mo yield in ^{235}U fission as 6.16. Fission yields of 20 nuclides in the fission of ^{239}Pu have been measured and tabulated. (2 tables) (INIS)

5102 (BARC/I-135, pp 62-68) RECOIL RANGES AND KINETIC ENERGY DISTRIBUTION IN THE NEUTRON INDUCED FISSION OF ^{231}Pa, ^{237}Np, ^{241}Am. Satya Prakash; Manohar, S. B.; Dange, S. P.; Ramaswamy, A.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). 1971.

Studies on the recoil ranges, kinetic energy distributions and kinetic energy deficits in the neutron-induced fission of ^{241}Am are reported. Data obtained on the recoil range and kinetic energy of the fission products are given. Secondary kinetic energy and total primary kinetic energy of each fission product are calculated by using three different range–energy relationships developed by (i) Lindhard–Scharf–Shiatts, (ii) Alexander and Gazdik and (iii) the authors themselves. Similar studies on ^{231}Pa and ^{237}Np are in progress. (4 figures, 1 table) (INIS)

5103 (CONF-720724-P2, pp 1-15) PROGRESS IN THE METHODOLOGY OF PLASTIC VISUAL DETECTORS PERMITTING A MORE COMPLETE STUDY OF THE FISSION AND FRAGMENTATION BY MEDIUM- AND HIGH-ENERGY PARTICLES. Debeauvais, M.; Gheysari, J.; Huss, D.; Rahimi, F.; Ralarosy, J.; Remy, G.; Stein, R.; Tripier, J. (Centre de Recherches Nucleaires, Strasbourg). 1972. (In French).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The use of the sandwich technique for solid track detectors of makrofol made it possible to determine and compare the part due to direct interactions in the fission reactions of U by 64-MeV α particles and of Pb by 70-MeV α particles by the single measurement of the angles between the two fragments. The cross sections for fission induced by 2.1-GeV deuterons were determined for U, Bi, and Pb by counting the number of events with two branches. All the studies were made in 4π geometry. (JSR)

5104 (CONF-720724-P2, pp 69-72) USE OF MICA AS DETECTOR FOR THE THEORETICAL STUDY OF ^{232}Th FISSION. Casanova, J.; Valle, J. (Univ., Valladolid, Spain). 1972. (In French).

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The distribution of the fission products of ^{232}Th at incident deuteron energies of 14.1 and 4.5 MeV was calculated theoretically, and the results of this calculation were compared with experimental results using mica as the detector. The experimental results are in very good agreement for the light fragments but not for the heavy fragments. For the heavy fragments the values of the mass numbers are higher than those obtained by the application of conservation principles. (2 figures) (JSR)

5105 (CONF-720724-P2, pp 90-102) FISSION STUDIES IN MICA USING THE HOLD DETECTOR. Vater, P.; Boos, A. H.; Brandt, R. (Univ., Marburg, Ger.). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The ratio of ternary fission to binary fission in the interaction of uranium with 414-MeV Ar ions was found to be (2.4 ± 1.0)%. This value was obtained by using the hole detector technique, as suggested by Starke. Some angular distributions of the fission fragments were also measured. The method was tested with natural uranium, irradiated with thermal neutrons. (6 figures, 1 table) (auth)

5106 (JAERI-1228, pp 1-12) EVALUATION OF URANIUM-235, 1. Matsunobu, H. (Sumitomo Atomic Energy Industries, Ltd., Osaka). Jul 1973. (In Japanese).

This is an interim report of the evaluation work on nuclear data of ^{235}U in the energy range from 1 keV to 15 MeV, which is a part of the work of the "Nuclear Data Evaluation Sub-working Group" in JNDC (Japanese Nuclear Data Committee). At present, this evaluation work on ^{235}U is based on the data compiled by the other sub-working group in JNDC. These compiled data mostly consist of new data measured after 1965. In Section 2 of this report, the status of the compiled nuclear data (σ_t, σ_f, $\sigma_{n\gamma}$, α, ν, σ_{el}, and σ_{in}) of ^{235}U is presented, and some problems are picked up in view of evaluation. Especially, systematic discrepancies of total cross sections in the energy range from 2 to 6 MeV and large differences of fission cross sections and α-values in the energy range from 1 to 100 keV are knotty problems in this evaluation work. In the case of elastic and inelastic scattering cross sections, the data are too poor to perform exact evaluation. In Section 3, a fundamental criterion to perform this evaluation work and a method of calculation to obtain the evaluated values of nuclear data are explained by using fission cross section as an example. (auth)

5107 (JAERI-1228, pp 13-24) STATUS OF EXPERIMENTAL DATA AND EVALUATIONS OF CROSS SECTIONS FOR ^{238}U(n,γ) AND ^{238}(n,n′) REACTIONS. Kanda, Y. (Kyushu Univ., Fukuoka). Jul 1973. (In Japanese).

Very accurate cross-sections for ^{238}U(n,γ) and ^{238}U(n,n′) reactions in the energy range from 1 keV to 10 MeV are required for the development of fast reactors. Available experimental data for these reactions are not accurate enough to satisfy the requests, and are in disagreement with each other. Several evaluations have been performed to deduce the most reliable cross sections for the reactions. In this report, evaluation methods and techniques are reviewed and discussed, mainly to clear up the contributions of experimental data and theoretical calculation to these works. It is valuable in the case of the capture cross-section to emphasize the experimental data assessment carried out by Davey and the simultaneous evaluation method employed by Sowerby et al. and Poenitz. On the other hand, since the experimental inelastic scattering cross-section data are too scarce to deduce cross sections for the neutron energy range required, it is necessary in this case for one to estimate from cross sections of other reactions for ^{238}U, being guided by calculations from, for example, the optical model formulae. (auth)

5108 (JAERI-1228, pp 25-35) RECENT STATUS OF FAST NEUTRON CROSS SECTIONS OF ^{239}Pu. Kawai, M. (Nippon Atomic Industry Group Co. Ltd., Tokyo). Jul 1973. (In Japanese).

The experimental data for ^{239}Pu reported after BNL-325, 2nd Edition (1958) have been compiled in order to evaluate the reaction cross sections of fast neutrons in the energy range from 1 keV to 15 MeV. Present status of the measured values for ν_p, α_{ot}, σ_f, σ_c is described and some problems related to the evaluation work are reported. The compiled experimental data are compared with the existing evaluated cross section data, for example with the σ_f of ENDF/B-III and of Davey. Present discrepancies among the measured values are pointed out and are discussed. It seems to be considered that one of the origins of α-value discrepancy lies in a method of estimation for resonance self-shielding effect, and the result of a calculation using the Bondarenko formula for the effect is reported. (auth)

5109 (JAERI-1228, pp 36-40) FAST NEUTRON CROSS SECTIONS OF ^{240}Pu. Murata, T. (Nippon Atomic Industry Group Co. Ltd., Tokyo). Jul 1973. (In Japanese).

The present status of the experimental fast neutron data on ^{240}Pu is reviewed for total, elastic scattering, inelastic scattering, fission and capture cross sections. To evaluate the cross sections in the energy range from a few keV to 15 MeV, these data are compared with that of neighboring nuclei, such as ^{239}U and others, and a method to estimate the cross sections of ^{240}Pu is discussed. (auth)

5110 (JAERI-1228, pp 64-78) REVIEW ON THE FISSION CROSS SECTION OF ^{235}U. Nishimura, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. (In Japanese).

The experimental data on the fission cross section of ^{235}U, which is important as one of the standard neutron cross sections, have been reviewed in the energy region from 100 eV up to 20 MeV. The references compiled are classified into three data groups; i.e., 1) VDG data, 2) LINAC data, and 3) BOMB data. The names of authors, published year, and experimental errors reported are tabulated separately in the three data groups. In order to display the status of discrepancies among various experimental data, the values of the fission cross sections are plotted in the following five energy regions: 1) 100 eV–100 keV, 2) 5–50 keV, 3) 50–300 keV, 4) 500 keV–1.2 MeV, and 5) 0.1–20 MeV. There are some LINAC or BOMB data including more than 60 data points in one experiment, and they are not plotted in the present review. The experimental data plotted are compared with the evaluation curve of Konshin and Nikolaev, as well as with Davey's one. The main origin of experimental errors in VDG data, normalization problem in LINAC data, and flux standards in BOMB data are investigated to clarify the problem of evaluation for the fission cross section of ^{235}U. (auth)

5111 (JAERI-1228, pp 170-182) MASS NUMBER DEPENDENCE OF CHARGE DISPERSION σ IN ^{235}U(n$_{th}$,f). Zukeran, A. (Hitachi Ltd., Kawasaki, Japan). Jul 1973. (In Japanese).

The most stable charge Z_A has been derived from Garvey's mass table, and the most probable charge Z_p in ^{235}U(n$_{th}$,f) has been estimated by ECD (equal charge displacement) hypothesis. Mass number dependence of the estimated Z_p does not agree very well with the semiempirical values obtained from the observed fractional yields by using the values of charge dispersion

σ = 0.55, 0.58, and 0.62. The charge dispersion σ has been also derived from the same observed fractional yields by using the estimated Z_p values, and the resultant σ values have been investigated from the point of view of dependencies on mass number A, neutron number N and proton number Z. It is found that there is an obvious systematics of N and Z dependencies in σ value, and A dependence of σ can be expressed by superposing of N and Z terms. If Z_p and σ depended only on the mass number A, there should be a point (Z_p, σ) common to all isobars in the Z_p vs. σ plane, where the common point (Z_p, σ) satisfies all of observed fractional yields for constant mass number A. However, study of the correlation between Z_p and σ indicates that such common points do scarcely exist. In conclusion, the charge dispersion σ depends upon the neutron number N, proton number Z, and thus mass number A; in particular, the dependencies upon N and Z seem to be essential. (auth)

5112 SPIN DETERMINATION OF RESONANCES IN THE NEUTRON-INDUCED FISSION OF ^{235}U. Keyworth, G.A.; Olsen, C.E.; Seibel, F.T. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Dabbs, J.W.T.; Hill, N.W. Phys. Rev. Lett. 31: No. 17, 1077-1080 (22 Oct 1973).

A pulsed beam of polarized neutrons and a polarized ^{235}U target have been used to determine the spins of 65 resonances below 60 eV. Comparison of these spin assignments with those determined by less direct methods reveals poor agreement in general. Interpretation of recent data on the angular distribution of fission fragments from aligned ^{235}U with the present spin assignments reveals the absence of the K=0 channel and an apparent admixing of transition states. (auth)

5113 SPECTROSCOPIC INVESTIGATIONS OF THE DECAY ^{223}Ra → ^{219}Rn. Richter, B.; Canty, M. J.; Ley, L.; Banaschik, M. V.; Neskakis, A. (Univ., Bonn). Nucl. Phys.; A223: No. 2, 234-252(1974).

Internal conversion electron spectra of the transitions 4.4 keV, 10.0 keV, 14.4 keV, and 324.1 keV in the decay ^{223}Ra → ^{219}Rn were measured. E2/M1 mixing ratios of these γ-transitions were deduced from conversion electron intensity ratios: δ^2 = 3.8(4) · 10^{-3}, 2.35(18) · 10^{-3}, 12.85(36) · 10^{-3}, 0.23(3). The half-lives of the 4.4 and 14.4 keV levels were determined as $T_{1/2}$ = 15.4(1.3) nsec and 0.875(30) nsec. Reduced transition probabilities were calculated and compared to the Weisskopf estimates. $\alpha\gamma$ angular correlation measurements of the transitions 269.6 keV, 324.1 keV, and 338.6 keV and an $\alpha\gamma$ linear polarization measurement of the 269.6 keV transition were performed for spin determination. I = 1/2 is assigned to the ^{219}Rn ground state and I = 5/2 or 9/2 to the 269.6 keV state. All other low excitations including the 338.6 keV level have spins I = 5/2, 7/2, or 9/2. The spins of the states 158.7 keV and 14.4 keV are equal. The ^{223}Ra ground state spin is I = 7/2 or 9/2. The possibility of an interpretation of the transitional nucleus ^{219}Rn in the frame of the collective model is discussed. (auth)

5114 COMPARISON OF NEUTRON RESONANCE SPACINGS WITH MICROSCOPIC THEORY FOR NUCLEI WITH STATIC DEFORMATION. Huizenga, J. R.; Behkami, A. N.; Atcher, R. W.; Sventek, J. S.; Britt, H. C.; Freiesleben, H. (Univ. of Rochester, NY). Nucl. Phys.; A223: No. 3, 589-598(1974).

A level density formula including low energy rotational levels for nuclei with axially symmetric deformation is tested with neutron resonance data for lanthanide and actinide nuclides. The calculations with the microscopic theory including nuclear pairing utilize deformed single particle levels of Nilsson et al. The experimental data for the actinide nuclei and the lanthanide nuclei are consistent with a theory which includes collective rotational levels. The derivation and applicability of a level density formula which includes collective rotational levels are discussed. (auth)

5115 THERMAL-NEUTRON SCATTERING CROSS SECTIONS OF ^{233}U AND ^{232}Th. Green, L.; Mitchell, J. A. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 54: No. 1, 18-27(May 1974).

Neutron scattering cross sections were measured for ^{233}U and ^{232}Th, through use of rolled metal samples, in a moderated spectrum from a 5-mg ^{252}Cf source. The scattered neutrons were detected by two ^{3}He detectors in an annular geometry. The experimental data were corrected for thermal and epithermal fissions, epithermal scattering, air scattering, room background, and self-absorption. The self-absorption corrections for the four ^{233}U targets, covering a wide range in thickness, were obtained from Monte Carlo calculations. Absorption corrections for the two ^{232}Th targets were avoided by using standards having the same absorption thicknesses. The results obtained were 12.30 ± 0.70 b for ^{233}U and 12.78 ± 0.30 b for ^{232}Th relative to vanadium with an assumed scattering cross section of 5.02 ± 0.10 b. The corresponding values for the ENDF/B-III file are 14.06 and 11.92 b, respectively. (9 figures, 5 tables) (auth)

5116 CORRELATION MEASUREMENTS OF THE ENERGY, MASS, AND ANGULAR DISTRIBUTIONS OF THE FRAGMENTS OF ^{235}U FISSION WITH THERMAL NEUTRONS. Kashukeev, N.; Dragnev, T.; Kalinkova, N.; Ivanov, I.; Chikov, N.; Bochvarov, S.; Aidemirski, P. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 24: 159-170(1973). (In Russian).

Correlation measurements of mass, energy, and angular distributions of the fragments of ^{235}U fission with thermal neutrons were carried out by means of a double impulse ionization chamber. The information, obtained as three numbers for each act of fission, was processed by computer. By means of computer, analysis and selection of the events according to a given feature was accomplished. Sections of multidimensional distributions in the form of energy, mass, and angular distributions of the fission fragments were obtained. (13 fig, 2 tables) (auth)

5117 ORIGIN AND AGE OF THE ELEMENTS. Hauge, O. (Univ. of Oslo). Naturen; 97: No. 3, 107-116(1973). (In Norwegian).

The elemental and isotopic abundance on the Earth, Moon, in meteorites, the Solar system and the Milky Way system is discussed as an introduction. The distributions are stated to be systematic. It is then shown that fusion processes may account for the formation of elements up to ^{24}Mg, ^{28}Si and ^{32}S, α-processes may then account for formation of elements up to iron. The e-process, at temperatures over 10^9 °K, leads to a virtual equilibrium and formation of elements up to atomic weight 68. Neutron capture processes, slow or rapid, lead then to formation of series of elements and isotopes in the rest of the periodic table. Exceptions are ^{144}Sm and some other proton-rich isotopes which can only be formed by capture of fast protons, and light nuclei such as deuterium, lithium, beryllium and boron. These latter are assumed to be formed as collision fragments in the upper atmosphere of certain types of stars. Finally, the isotope ratios ^{235}U/^{238}U and ^{232}Th/^{238}U are used to estimate the time of the last modification of the elements abundance distribution. This is found to have taken place about 6.5×10^9 years ago. (NO)

5118 NEUTRON MULTIPLICITY MEASUREMENTS FOR NEUTRON-INDUCED FISSION OF ^{233}U AND ^{235}U. Reed, R. L. Troy, NY; Rensselaer Polytechnic Inst. (1973). 219p. University Microfilms Order No. 74-5153.

Thesis (Ph.D.).

Measurements of prompt neutron emission as a function of incident neutron energy for fission of ^{233}U and ^{235}U were made using multiplate fission chambers and a Gd-loaded liquid scintillator tank. The neutron source was the R.P.I. LINAC and incident neutron energies were determined by the time-of-flight method. Nubar values were determined for ^{235}U in the thermal to 30 eV energy range and for ^{233}U in the thermal to 100 eV energy range. Nubar was measured to be constant to 0.1% in the thermal region from 0.011 to 0.1 eV for both ^{233}U and ^{235}U. In the epithermal energy range relative nubar values were determined for each resolvable resonance and the data were normalized to established nubar thermal values. For ^{235}U, the distribution of the resonance nubar values can not be fit by a single population. If one assumes two populations, then $\bar{\nu}$ (nubar) falls into two groups separated by about 0.5% with mean values of 2.406 ± 0.002 and 2.417 ± 0.002. Statistical errors (standard deviations) for the ^{235}U resonance nubar values range from 0.1 to 0.3%. The maximum deviation from the average of all the resonance nubar values is 0.7% while the maximum difference between any two resonance nubar values is 1%. Resonance spin assignments for ^{235}U are made based on the assumed nubar grouping. The ^{233}U resonance nubar values also exhibit variations not consistent with a single population. However no definitive groupings as for ^{235}U are observed. The statistical errors on the ^{233}U resonance nubar values range from 0.1 to 0.5% with maximum deviations from the average of 1% and maximum resonance-to-resonance differences of 2%. (Diss. Abstr. Int., B)

5119 EXPERIMENTS ON SYNTHESIS OF SUPERHEAVY NUCLEI BY REACTIONS WITH Ge IONS. Flerov, G. N.; Oganesyan, Yu. Ts.; Lobanov, Yu. V.; Pleve, A. A.; Ter-Akop'yan, G. M.; Demin, A. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 492-498(Mar 1974). (In Russian).

Experiments on the synthesis of superheavy nuclei by irradiating ^{232}Th and ^{238}U with ^{74,76}Ge ions accelerated in the JINR tandem-cyclotron are described. The experimental technique has permitted the detection of spontaneous fission of isotopes with half-lives from 1 msec to 1 year. The upper limit of the production cross section for superheavy nuclei in the reactions (^{232}Th + ^{74,76}Ge) is determined to be 10^{-34} cm^2. The factors which determine the production cross section value for superheavy nuclei in these reactions are discussed. (auth)

5120 ENERGY DEPENDENCES OF THE FISSION AND NUCLEON TRANSFER CROSS SECTIONS IN THE INTERACTION

OF ^{232}Th WITH THE ACCELERATED ^{74}Ge IONS. Oganesyan, Yu. Ts.; Nadkarni, D. M.; Penionzhkevich, Yu. E.; Pustylnik, B. I.; Nguen Tak An. (Joint Inst. of Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 486-491(Mar 1974). (In Russian).

The energy dependences of the fission and nucleon transfer cross sections are investigated for the interaction of ^{232}Th with the accelerated ^{74}Ge ions. It is shown that the Coulomb barrier of the fission is 30 MeV larger than the barrier of one and five nucleon transfer reaction. (auth)

5121 ALPHA BRANCHING RATIO OF ^{227}Ac. Monsecour, M.; De Regge, P.; Demildt, A.; Baetsle, L. H. (CEN, Mol, Belg.). J. Inorg. Nucl. Chem.; 36: No. 4, 719-723(Apr 1974).

A standard solution containing 504 ± 4 μg of actinium has been prepared by dissolving a weighed amount of purified Ac_2O_3. The ^{227}Ac concentration has been confirmed by microgravimetry and microphotometric EDTA titration with Arsenazo III as indicator. Starting from a known amount of this standard solution the alpha-branching factor of ^{227}Ac has been determined by three independent methods based respectively on the alpha-measurement of daughter-free ^{227}Ac, the alpha-spectrometric determination of the daughter activities in an equilibrium mixture and the observation of the daughter activity ingrowth immediately after the ^{227}Ac purification. The weighted mean value of the branching factor obtained was 1.359 ± 0.14%. (auth)

5122 TRANSFER REACTIONS: REACTION MECHANISM. pp 493-498 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Six papers on this topic are presented. They include studies of ^{232}Th bombarded with ^{22}Ne and ^{40}Ar, Ar-induced transfer reactions on several heavy targets, heavy-ion reactions involving large transfer of nuclear matter, and transfer reactions induced by ^{12}C and ^{14}N at high energies. (RWR)

5123 ELECTROMAGNETIC MOMENTS. Goldring, G. pp 165-181 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Important developments in the field of nuclear moments have occurred recently, relating both to novel techniques and to new significance and insight derived for such measurements. The magnetic hyperfine interaction of nuclei in isolated ions has received increasing attention. These are usually ions recoiling from a nuclear reaction. Two extreme regimes of excitation are encountered in such ions: hot ionization, in which the ions are produced in a complex mixture of a large variety of highly excited states, and cold ionization, in which the ions are produced predominantly in the ground state. An intermediate situation has also been dealt with recently. The emphasis in this paper is on cold ionization work. Highly accurate measurements which allow the extraction of essentially new information as small second-order modifications are also considered. The modification of the orbital angular momentum g factor of nucleons embedded in nuclear matter is discussed in this context. Similarly, the study of E4 moments is also described. (9 figures, 2 tables) (RWR)

5124 NUCLEAR FISSION. Specht, H. J. pp 311-350 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics, Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The discussion is restricted to the following topics: present understanding of the double-humped fission barrier with all its experimentally observable consequences; the possible connection between the barrier shape and fragment mass distributions. It is concluded that experimental evidence supporting the double-humped barrier picture has been accumulating rapidly in the last few years, and in several respects nearly quantitative agreement is found with theoretical predictions, although some difficulties still remain. Major problems exist, however, in the understanding of fragment mass distributions. (20 figures) (RWR)

5125 SYNTHESIS OF SUPERHEAVY ELEMENTS. Oganessian, Yu. Ts. pp 351-365 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The possibilities of synthesizing superheavy elements are outlined. Two methods of synthesis are discussed: fusion reactions leading to the formation of a compound nucleus and production in the form of fragments from fission of very heavy excited nuclei. Data from investigations of both types are discussed, with theoretical details and analysis of unsuccessful attempts omitted. (8 figures, 1 table) (RWR)

5126 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Marz 1974. Band 8, Heft 3. 188 Referate (Register-Nr. 810-1190); 79 Referate (Register-Nr. 193T-271T). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. March 1974. Vol. 8, No.3. 188 Abstracts (Register No. 810-1190); 79 Abstracts (Register No. 193T-271T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (Mar 1973). 123p. (In German and English).

5127 GAMMA BRANCH OF THE ^{238}U SHAPE ISOMER. Russo, P. A. Seattle; Univ. of Washington (1973). 127p. University Microfilms Order No. 74-2278.

Thesis (Ph. D.)

An experimental investigation of the gamma branch of the ^{238}U shape isomer was undertaken. The even-even ^{238}U shape isomer is systematically assigned as a ground state in the second minimum. The anticipated shape isomer excitation energy is between 2 and 3 MeV. The decay of the 0^+ shape isomer is expected to be dominated by a single transition to the first excited 2^+ state in normally-deformed ^{238}U. Therefore, a gamma ray of 2 to 3 MeV with a 200 nsec half life was sought. ^{238m}U was produced by the ^{238}U(d,pn) reaction with 18 MeV deuterons. The deuteron beam was pulsed, and delayed gamma rays were timed against the beam pulser oscillator signal. Both energy and time were recorded for each gamma ray. The resulting energy spectra were compared with spectra obtained in the same type of experiment with two different reactions which cannot populate the ^{238}U shape isomer. A high energy line at 2.5 MeV with a half life consistent with the ^{238}U shape isomer half life is unique to the 18 MeV deuteron experiment. A second weaker line at 1.9 MeV is also consistent with the measured half life of ^{238m}U. The energies of these two lines fit the decay scheme corresponding to de-excitation of a 0^+ state in ^{238}U to the known first excited 2^+ and 1^- states in ^{238}U. The observation of these lines which was attributed to the gamma decay of 200 nsec ^{238m}U correspond to the first experimental observation of the shape isomer gamma branch. Limits for the cross section of the ^{238m}U gamma branch were established. The cross section is shown to be consistent with the expectation of a deeper second minimum in uranium compared to plutonium corresponding to a more effective trapping situation for population of the uranium shape isomers. The partial half lives for the gamma branch and the fission branch of ^{238m}U were used to determine parameters for the ^{238}U fission barrier. A comparison with other empirically-determined barrier parameters provides some suggestions about the shapes of the two barriers in ^{238}U. The experimental results for the gamma branch also provide support for certain assumptions which are basic to the theoretical treatment of the gamma branch. (Diss. Abstr. Int., B)

Nuclear Theory

Refer also to abstracts 4291, 4447, 4450, 4563, 4700, 4754, 4815, 4892, 4901, 4902, 4913, 4966, 5004, 5056, 5084, and 5124.

5128 (COO-2271-27) ABNORMAL NUCLEAR STATES AND VACUUM EXCITATIONS. Lee, T. D. (Columbia Univ., New York (USA)). 1974. 30p. (CONF-740121-1). Dep. NTIS $4.50.

From annual bevatron users meeting; Berkeley, California, USA (19 Jan 1974).

Speculations are made on the existence of some interesting physical objects, hitherto unobserved, which can be searched for using high energy heavy ions. The discussion covers abnormal nuclear states, the sigma model, and pure vacuum excitation. (JFP)

5129 (COO-3058-49) OPTICAL MODEL CALCULATIONS AT RENSSELAER POLYTECHNIC INSTITUTE. Sierra, J. M.; Turinsky, P. J. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Nuclear Engineering). 1974. Contract AT(11-1)-3058. 26p. Dep. NTIS $4.50.

Experimental evidence of deep minima in the p-wave neutron strength function about mass numbers 55 and 160 has been studied via optical-model calculation. By employing a spherical optical model with an angular momentum-dependent (l) imaginary potential strength (W^l), a global optical-model parameter set was determined which accurately predicts the s- and p-wave neutron

strength functions and potential scattering radius over mass numbers 40–240. Extension of the angular momentum-dependent optical potential to coupled-channel calculations treating 0^+-2^+ collective-state coupling improved the agreement between prediction and experimental data. The values $W^c = 12$ MeV and $W^l = 1.5$ MeV employed in the calculations indicate that p-wave neutrons effectively interact less weakly than s-wave neutrons with the target nucleus. (auth)

5130 (JEN-260) KINEMATICS OF LOW-ENERGY NUCLEAR PROCESSES. Sanchez del Rio, C. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 24p. (In Spanish). INIS.

Principles of energy and momentum conservation in nuclear processes are studied, particularly for nuclear reactions with two end particles, for elastic and inelastic collisions, and finally for nuclear processes with more than two end-particles; the kinetics of particles at each point of phase space was considered. (auth)

5131 (JEN-261) KINEMATICS OF HIGH-ENERGY NUCLEAR PROCESSES. Sanchez del Rio, C. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 33p. (In Spanish). INIS.

The nuclear processes in which the kinetic energy of the involved particles is not negligible as compared with their self-energy are studied. The study is based on the energy and momentum principles and uses the relativistic mechanics formulation and the Lorentz transform. A 4-dimensional vectorial formalism has been used and the above-mentioned concepts have been applied to the kinematics of simple processes; in addition, the energy and momentum of a particle has been calculated in the reference system of another one. Finally, the high-energy reactions between two or more particles have been analyzed by studying the occurrence probability and the momentum and energy distributions. (auth)

5132 N-BODY FORCES IN HIGH-DENSITY OF NUCLEAR MATTER. McKellar, B.H.J.; Rajaraman, R. (School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia). Phys. Rev. Lett. 31: No. 17, 1063-1067 (22 Oct 1973).

The contribution of n-body forces to nuclear matter energy is summed in closed form as a function of the nuclear density. It is seen that they provide an increasing amount of binding as the density increases beyond ordinary nuclear density. The presence of correlations suppresses this effect, but does not destroy it fully. The physics behind these phenomena is discussed. (auth)

5133 NONORTHOGONALITY EFFECTS IN SUCCESSIVE PARTICLE-TRANSFER REACTIONS. Udagawa, T.; Wolter, H.H.; Coker, W.R. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712). Phys. Rev. Lett. 31: No. 25, 1507-1510 (17 Dec 1973).

It is demonstrated that nonorthogonality effects can play a very important role in multistep processes involving successive particle-transfer reactions. This is shown for the particular example of the (^{3}He,d)-(d,t) process, where nonorthogonality terms can be included as a renormalization of the effective interaction for the direct (^{3}He,t) charge-exchange process. (auth)

5134 SIMPLE POTENTIAL MODEL FOR NUCLEUS-NUCLEUS INTERACTIONS. Vary, J.P.; Dover, C.B. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 31: No. 25, 1510-1513 (17 Dec 1973).

We construct a simple optical potential for nucleus-nucleus processes by a folding method. With these potentials, we have obtained high-quality fits to a variety of elastic-scattering data. We also successfully reproduce one-particle transfer data. However, two-particle transfer results may indicate the need for further refinements of the model. In addition, we calculate the bound states of an $\alpha + {}^{16}$O folded potential. There is good agreement with experimental energies and α widths for two α-cluster bands in ^{20}Ne. (auth)

5135 COMMENT ON "π CONDENSATION IN NUCLEAR MATTER". Sawyer, R.F. (Aspen Center for Physics, Aspen, Colorado 81611). Phys. Rev. Lett. 31: No. 26, 1556-1559 (24 Dec 1973).

Recent remarks on the possibility of negative-pion condensation in superdense nuclear matter are shown to be based on an incorrect formalism. The possibilities of π^- and π^0 condensation are compared and some problems are enumerated which must be solved before it is known which, if either, of the phenomena can occur. (auth)

5136 ANGULAR-MOMENTUM DEPENDENCE OF THE DENSITY OF STATES. Ginocchio, J.N. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 31: No. 20, 1260-1263 (12 Nov 1973).

An approximate angular-momentum dependence of the energy centroid and width of the distribution of shell-model states derived from the theory of continuous distributions is compared with the exact results obtained from the diagonalization of shell-model states. The agreement is found to be very good. A density of shell-model states as a function of energy and angular momentum is presented which should be valid for nuclei with a large number of valence particles. (auth)

5137 ROLE OF COINCIDENCE EXPERIMENTS IN STUDIES OF μ CAPTURE AND RADIATIVE π CAPTURE BY NUCLEI. Balashov, V.V.; Korenman, G.Y.; Eramzhyan, R.A. (Institute of Nuclear Physics, Moscow State University, Moscow). Sov. J. Part. Nucl. 4: No. 2, 247-259 (Oct 1973).

Coincidence experiments yield the most detailed information about nuclear structure and the mechanisms for nuclear processes. The current state of and outlook for study of μ and radiative π capture in coincidence experiments are reviewed. Problems associated with transitions to discrete levels of the final nucleus, fast-neutron emission, and excitation of giant resonances are discussed. (auth)

5138 NUCLEON—NUCLEUS DIFFRACTION SCATTERING AND NUCLEAR STRUCTURE. Sitenko, A.G. (Institute of Theoretical Physics, Academy of Sciences, Ukrainian SSR). Sov. J. Part. Nucl. 4: No. 2, 231-246 (Oct 1973).

This paper is devoted to a consideration of elastic and inelastic nucleon—nucleus scattering at high energy in the diffraction approximation. For particle scattering in a central field, a solution of the Lippman-Schwinger equation in the high-energy approximation is discussed. On the basis of the resultant solution, a generalized Huygens principle describing nuclear diffraction processes is formulated. Scattering of a fast particle by a system of bound particles is discussed and the effects of multiple scattering are investigated. Nucleon scattering by the simplest nucleus–the deuteron– is considered in detail. The diffraction approximation is compared with various versions of the impulse approximation. Using elastic scattering of protons by the ^{12}C nucleus as an example, a quantitative estimate is made of the accuracy of the plane-wave impulse approximation and of the distorted-wave impulse approximation as compared to the diffraction approximation. The multipole formalism used for the description of nucleon–nucleus inelastic scattering in the case of small momentum transfer is considered in detail. A number of specific inelastic transitions induced in nuclei by high-energy protons are discussed. Various possibilities for extracting information about nuclear structure from nucleon–nucleus scattering data at high energies are discussed. (auth)

5139 APPROXIMATE TREATMENT OF RECOIL EFFECTS IN HEAVY ION TRANSFER REACTIONS. Braun-Munzinger, P.; Harney, H. L. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A223: No. 2, 381-393(1974).

A DWBA formalism is developed that allows for recoil and finite range effects in transfer reactions between heavy ions. Under the assumption of strong absorption and with a local momentum approximation a formula for the transition matrix element is derived that may be incorporated into conventional DWBA codes. Additional complications essentially appear in the angular momentum structure which allows for both natural and unnatural angular momentum transfers. Both target and projectile are treated symmetrically. The approximations specific to the present treatment are thoroughly discussed and shown to be realistic. (auth)

5140 SPECTRAL DISTRIBUTIONS AND THE BREAKING OF ISOSPIN AND SUPERMULTIPLET SYMMETRIES IN NUCLEI. Hecht, K. T.; Draayer, J. P. (Univ. of Michigan, Ann Arbor). Nucl. Phys.; A223: No. 2, 285-319(1974).

Knowledge of the Racah algebra for the higher unitary groups is exploited to give a general formula for the partial widths for the direct product subgroup $U(N/k) \times U(k)$ of the full unitary group U(N) of a given shell model vector space. This formula makes it possible to separate the second moments of dynamical operators into the internal and external parts which are needed for detailed applications of the spectral distribution technique. Specific applications are made for k = 2 (isospin) and k = 4 (Wigner supermultiplet symmetry). Explicit expressions are given for the isospin breaking contributions to the spectral widths which make it possible to estimate the intensities of isospin impurities in an average state of a given isospin. The goodness of Wigner supermultiplet symmetry is examined for the 2s-1d shell with a detailed example, the A = 25 nuclei, for which partial widths were calculated for various modifications of the Kuo-Brown interaction to give a simple measure of the amount of mixing to be expected between states of different space symmetry. (auth)

5141 COULOMB WAVE FUNCTION. Sahai, G. (Univ. of Lucknow, India). Compt. Rend. Acad. Bulg. Sci.; 27: No. 1, 15-18(1974).

An evaluation is made of both regular and irregular Coulomb wave functions for all values of the angular momentum quantum number as a product of associated Legendre functions and generalized confluent hypergeometric functions. (JFP)

5142 APPROACH TO THE THEORY OF UNSTABLE STATES. Agodi, A.; Baldo, M.; Recami, E. (Istituto di Fisica Teorica dell'Università di Catania, Italy). Ann. Phys. (N.Y.) 77: No. 1, 157-173 (1 May 1973).

In this work, a new method introduced by one of us (A.A.) has been followed, in order to analyze the effects produced by an internal (virtual) state $|\phi>$ on the transition amplitudes and, in particular, to single out the necessary conditions that $|\phi>$ is connected with a resonance in the cross section. In the case of potential scattering, for instance, the resonance determination by means of the Kapur and Peierls method is shown to be equivalent to the determination of the spectral function of a quasi self-adjoint operator (whose anti-Hermitian part is defined by means of a single state). In general, by associating unstable states with the eigenvalues of quasi self-adjoint Hamiltonians, a new definition of Resonance may be given. The application of this method to the study of resonances related to a spherical-well potential seems to confirm the validity of our method. (auth)

5143 PROJECTION AND THE REMOVAL OF NONVIBRATIONAL CORRELATIONS FROM STATES OF THE RANDOM PHASE APPROXIMATION. Johns, O. (Physik Dept. T-30, Technische Universität, 8046 Garching bei München, W. Germany). Ann. Phys. (N.Y.) 77: No. 1, 216-229 (1 May 1973).

When the Hartree-Fock state violates symmetries of an n-Fermion system, the random phase approximation (RPA) has zero-energy eigenmodes. It has been noted that such modes are not true vibrations but are translations with no restoring force, and that the RPA ground state should therefore not contain correlations corresponding to them. This paper presents an explicit RPA ground state without such correlations, and shows that it is consistent with the RPA Hamiltonian only when the dynamical system is modified by projection onto eigenstates of conserved quantities. The projection is done by a method of equivalent-operators in which the expectation value of an operator between projected states is approximated by that of an equivalent-operator between the original states. The method is combined self-consistently with the RPA to give a projected-RPA theory, and is also applied to the evaluation of other physical operators. (auth)

5144 ROTATIONAL BANDS IN NUCLEI AS INDUCED GROUP REPRESENTATIONS. Weaver, L. (Department of Physics, Kansas State University, Manhattan, Kansas 66502); Biedenharn, L.C.; Cusson, R.Y. Ann. Phys. (N.Y.) 77: No. 1, 250-278 (1 May 1973).

A one-to-one correspondence between all constant deformation rotational bands in nuclei and the set of all unitary irreducible representations of the symmetry group $T_5 \circledcirc SU2$ is successfully made. The physical observables corresponding to the generators of this noncompact symmetry group are the angular momentum operator j and the traceless mass quadrupole moment operator q. Three types of band structure are found: α bands, having zero quadrupole moment, and a single j value; β bands (three kinds: β^{+}_{k} and $\beta^{+}_{0,s}$) representing axial nuclei; and γ bands (five kinds: $\gamma^{a,b}_{s,s}$ and $\gamma^{a,b}_{7}$) representing nonaxial deformed nuclei. The fifth γ-band type $\gamma^{a,b}_{7}$ is especially interesting in that it has, intrinsically, half-integer angular momenta; this band, in particular, has not been obtained previously as an elementary structure. Properties of these bands (representations) are discussed in detail. It is noteworthy that all irreps of this symmetry group ($T_5 \circledcirc SU2$) find physically occurring counterparts, and conversely, no known rotational band system fails to find an associated irrep structure. (auth)

5145 TOROIDAL AND SPHERICAL BUBBLE NUCLEI. Wong, C.Y. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Ann. Phys. (N.Y.) 77: No. 1, 279-353 (1 May 1973).

Attention is fixed on nuclei with new types of topology proposed by Wheeler many years ago. Only the most important types of instability arising from collective deformations are considered in conjunction with only the simplest new topologies, those of a torus and a bubble. In the liquid-drop model, a toroidal nucleus with a fissility parameter $x \gtrsim 1.0$ is stable against symmetry-preserving breathing deformations due to the balance between Coulomb repulsion and surface tension. However, at the breathing deformation minimum, the nucleus is unstable against sausage deformations which make the torus thicker in one section and thinner in another. Simple vorticity does not help to stabilize such a nucleus against sausage deformations. A spherical liquid-drop bubble nucleus is stable against breathing deformation for $x \gtrsim 2.1$, in which case it is nonetheless unstable against one type of spheroidal deformation or another. Attention is turned to the independent particle model, where one finds shells in both the toroidal and the bubble nuclei in their breathing deformation degrees of freedom. The presence of these shells allows some "doubly-magic" toroidal and bubble nuclei to gain additional stability against breathing deformations, whose deformation energy surfaces are studied with Strutinsky's theory of renormalization. Aproximate shell-model calculations reveal further that a shell in the breathing deformation of a toroidal nucleius is also a shell in its sausage deformation. Insofar as liquid-drop-type instability in the sausage deformation degree of freedom can be effectively counterbalanced by the stabilizing tendencies due to shells, which is thus suggested but is yet to be worked out in detail, there are doubly magic toroidal nuclei stable against collective deformations. The situation is similar but more definite for the bubble nuclei. There are doubly magic spherical bubble nuclei stable against collective vibrations. Stability against spheroidal deformations is not of major concern there mainly because a spherical bubble nucleus with $x < 1.0$ is stable against spherical deformations even in the liquid-drop model. Furthermore, additional stability may be gained as a shell in the breathing deformation is also a shell in the spheroidal deformation degrees of freedom. (auth)

5146 THE ENERGY DENSITY FORMALISM IN NUCLEI. Lombard, R.J. (Institut de Physique Nucléaire, Division de Physique Théorique, 91, Orsay, France). Ann. Phys. (N.Y.) 77: No. 1, 380-413 (1 May 1973).

A revised version of the energy density formalism is presented which allows one to describe the bulk properties of nuclei accurately. As far as the binding energies are concerned, the approach is shown to be competitive with semiempirical mass formulas. The nuclear radii are also in good agreement with experiment. Calculations of the electron scattering differential cross section at medium energy show, however, that the surface of charge distributions is not yet satisfactory. An extension of the functional giving the total energy density is proposed in which the single-particle structure of nuclei is taken into account. In a first step the many-body wavefunction corresponds to a Slater determinant of single-particle wavefunction but extension to more general wavefunction is straight forward. This extended approach is similar to the local density approximation. (auth)

5147 IMPROVED THEORETICAL PION-NUCLEUS OPTICAL POTENTIALS. Landau, R.H.; Phatak, S.C.; Tabakin, F. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Ann. Phys. (N.Y.) 78: No. 2, 299-339 (June 1973).

An approach which makes the first order pion-nucleus optical potential theoretically sound is presented. This study should permit higher order improvements to the potential to be more meaningful and the nuclear structure information extracted from pi-nucleus scattering to be more reliable. Based on multiple scattering theory, three optical potentials are constructed and studied in momentum space. These models are the popular Kisslinger potential, the local "Laplacian" potential, and an "improved off-shell potential;" the latter one is derived from absorptive separable pion-nucleon potentials which exactly reproduce on-shell πN scattering. By working in momentum space and explicitly including πN resonances and off-shell effects in the definition of the optical potential, the approach described here is capable of handling any number of pi-nucleon partial waves, is applicable over a very wide energy region, is based on a physical model for off-shell behavior, and is extended easily to include higher order effects. The optical potentials are inserted into two different relativistic wave equations to determine the total cross section and elastic differential cross section for pi-nucleus scattering. It is found that the various models for off-shell πN scattering determine significantly different πC^{12} scattering, with the improved off-shell model preferred on theoretical grounds. Also discussed is the importance of properly transforming πN scattering to the pi-nucleus c.m. system, the origin of the shift in the peak position of the π C total cross section, and the reason for the increased diffractive nature of the differential cross section at 180 MeV. (auth)

5148 ON THE GROUND STATE OF AN IMPURITY IN A DILUTE FERMI GAS. Bishop, R.F. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 78: No. 2, 391-420 (June 1973).

The system under consideration is a large collection of identical fermions (B), forming a background, into which is inserted a relatively small number of distinct impurity (I) particles. The background is considered to be dilute in the sense that $R \gg a$, where R is the average separation of the B particles, and a is the range of their interaction potential; and the I particles are so dilute with respect to the B particles that I-I interactions can be ignored. The I particles are then all essentially at rest in their ground state. The BB and BI interaction potentials are chosen to be hard cores of the same range a. A series expansion is developed for the ground-state energy of the I particles, and the first four terms are calculated explicitly using two distinct methods, employing Feynman and Goldstone diagrams respectively. It is shown that each method has distinct advantages over the other, and that a judicious combination of both can be used to considerable benefit. (auth)

5149 ON THE PERTURBATION APPROACH TO THE PARTICLE-VIBRATION COUPLING MODEL. Vanden Berghe, G.; Waroquier, M. (Rijksuniversiteit-Gent, Belgium Instituut voor Nukleaire Wetenschappen, Proeftuinstraat 86, B-9000 Gent, Belgium); Heyde, K. Ann. Phys. (N.Y.) 78: No. 2, 467-495 (June 1973).

The particle-vibration coupling model is treated in a perturbation approach in order to (i) obtain simple expressions for the reduced E2 transition probabilities and thus derive approximate selection rules and

(ii) study the convergence properties of the perturbation series (up to sixth-order) by comparing with the exact diagonalization procedure. The results are in both cases compared with diagonalization results and the experimental data available on ^{121}Sb and ^{123}Sb. The perturbation expansion, treated to higher order, can be performed easily in terms of a diagrammatic method based on Goldstone and Jutsis-Bandzaitis-Vizbaraite formalisms. It is shown that the perturbation method gives reliable results if "physical" single-particle energies are used instead of "bare" single-particle energies with the neglect of all self-energy corrections and a renormalized particle-vibration coupling strength. This higher order perturbation expansion is applied to the case of ^{119}Sb and ^{123}Sb. (auth)

5150 DEVIATIONS FROM THE RUTHERFORD SCATTERING DUE TO THE GROUND STATE QUADRUPOLE MOMENT. Alder, K.; Roesel, F. (Institute of Theoretical Physics, University of Basel, Switzerland); Smilansky, U. Ann. Phys. (N.Y.) 78: No. 2, 518-534 (June 1973).

The deviations from the pure Rutherford scattering due to the finite quadrupole moment in the ground state has been recalculated to second order in the quadrupole moment. It is shown that for unpolarized targets the deviations are small once the excitations into higher states are taken into account. The smallness of the effect is due to a strong cancellation between the two second order terms in the perturbation expansion. This fact was not realized by the authors who dealt previously with this problem. For polarized or aligned targets the first order amplitude contributes most of the effect and deviations of the order of 10% are expected. Finally, a convenient parameterization of the deviations is presented. (auth)

5151 DISCUSSION OF THE STRUCTURE OF NUCLEAR ROTATION AT HIGH ANGULAR MOMENTA. Krumlinde, J. (Department of Mathematical Physics, Lund Institute of Technology, Lund, Sweden); Szymański, Z. Ann. Phys. (N.Y.) 79: No. 1, 201-249 (July 1973).

A schematic two-level model is introduced and developed in order to describe the nuclear rotation at high angular momenta. For this problem there exists a symmetry of the Lie algebra belonging to the group R(8). The implications of this symmetry including various subalgebras of R(8) corresponding to different particular cases are studied. It is found that the model is able to describe qualitatively (i) the phase transition from the superfluid to the normal state, (ii) the band structure in the region above the phase transition, and (iii) the retardation of the gamma transitions across the phase transition. (auth)

5152 THE PAIRING MODEL. Broglia, R.A. (The Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark). Ann. Phys. (N.Y.) 80: No. 1, 60-85 (Sept 1973).

The consequences of the existence of pairing correlations in nuclei are discussed. Special attention is paid to the dynamical aspects of the pairing degree of freedom, as revealed by two-nucleon transfer reactions. These reactions constitute specific probes of the pairing collective modes. The mathematical framework in which the discussion is carried out is the BCS theory and the Random Phase Approximation. The borderline aspect of the subject, which lies between solid state and nuclear physics is emphasized, pointing out the similarities and differences between analogous phenomena of solid state and nuclear physics. (auth)

5153 ON THE HIGH ENERGY SCATTERING OF PROTONS BY NUCLEI AND TRIPLE CORRELATIONS. Ullo, J.J.; Feshbach, H. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts). Ann. Phys. (N.Y.) 82: No. 1, 156-188 (Jan 1974).

The multiple scattering theory of Kerman, McManus, and Thaler is extended to include triple scattering effects. With a judicious choice of the propagator between scatterings the triple scattering term is approximately proportional to the triple correlation function. The methods of Feshbach, Gal, and Hufner are generalized to provide a coupled channel description of the elastic scattering of fast particles including triple scattering. The coupling potentials depend directly on the pair and triple correlation functions. Numerical calculations are performed for protons of 1.69 BeV/c momentum on ^{4}He. Center-of-mass correlations and phenomenological short-range dynamical correlations are tested using a spin isospin averaged nucleon-nucleon amplitude. The differential cross section around the second diffraction minimum and third diffraction peak is particularly sensitive to triple scattering effects. Present experimental accuracy around the third diffraction peak does not permit any definitive conclusions to be made. (auth)

5154 INSTABILITY OF THE QUASI-PARTICLE VACUUM AND BAND CROSSING IN HIGH SPIN ROTATIONAL STATES. Lin, L. (Univ., Frankfurt am Main); Dreizler, R. M.; Chi, B. E. Phys. Lett.; 49B: No. 2, 117-119(1 Apr 1974).

It is shown that the energy of the quasi-particle excitation in a rotational system may become negative when the angular frequency ω reaches a certain value. As a result, the energy of the excited state may be lower than the energy of the quasi-particle vacuum. It is suggested that this may serve as a natural explanation of the recently observed band-crossing phenomena where the levels of the "excited-band" become lower than the levels of the "ground-band" after a certain value of angular momentum. Preliminary calculation agrees well with the experimental result obtained in Juelich for ^{156}Dy. (auth)

5155 EXCITATION OF DISCRETE NUCLEAR LEVELS IN PARTICLE PRODUCTION. Balashov, V. V.; Korotkikh, V. L.; Mileev, V. N. (Moscow State Univ.). Phys. Lett.; 49B: No. 2, 120-122(1 Apr 1974).

The mechanism of coherent particle production with the excitation of discrete nuclear levels is discussed. The suggested theory accounts for the recent experimental data on the $^{12}C(\pi,3\pi)^{12}C^*$ (2^+, 4.44 MeV). (auth)

5156 ANGULAR MOMENTUM DISTRIBUTION OF FISSION FRAGMENTS AS A RESULT OF BENDING MODES AT THE SCISSION POINT. Zielinska-Pfabe, M.; Dietrich, K. (Technische Univ., Munich). Phys. Lett.; 49B: No. 2, 123-128(1 Apr 1974).

Assuming that only the bending modes carry angular momentum at scission, the average momentum of the fission fragments is calculated as a function of mass number and of the "nuclear temperature" T at scission. The best agreement between the experimental data and the theoretical results is obtained for kT = 2-3 MeV. The adiabatic limit is clearly disfavored. (auth)

5157 STATISTICAL MODEL FOR ENERGY DISTRIBUTIONS IN ACTINIDE FISSION. Facchini, U.; Saetta-Menichella, E. (Univ., Milan). Phys. Lett.; 49B: No. 2, 153-156(1 Apr 1974).

A model is proposed which, through a statistical description of the fission process, makes it possible to describe the properties of fragment excitation and kinetic energy distributions and the non-correlation of excitation energies. (auth)

5158 LARGE SUPERFLUIDITY ENHANCEMENT IN THE PENETRATION OF THE FISSION BARRIER. Moretto, L. G.; Babinet, R. P. (Univ. of California, Berkeley). Phys. Lett.; 49B: No. 2, 147-149(1 Apr 1974).

The least action principle is used to determine the semiclassical path in the penetration of a multidimensional fission barrier using the gap parameter as a dynamical variable. An increase in the gap parameter, the larger the deeper the penetration of the barrier is predicted. (auth)

5159 THEORY OF THE ABSORPTION OF γ QUANTA BY NUCLEAR SPIN SYSTEMS. Safaryan, F. P. (Inst. of Physics Research, Erevan). Dokl. Akad. Nauk Arm. SSR; 55: No. 3, 156-162(1972). (In Russian).

The γ absorption coefficients for nuclear spin systems are calculated by use of the temperature Green's function for the general case of indirect interaction of the spin system with the lattice. In the specific case of the quadrupole spin-phonon interaction, the role of new temperature-dependent terms on the intensity and position of line widths is evaluated approximately. (JSR)

5160 OCTUPOLE DEFORMATION OF NUCLEI. I. Tsuruda, D.; Honda, T. (Yamanashi, Univ., Kofu, Japan). Yamanashi Daigaku Kyoikugakubu Kenkyu Hokoku; No. 21, 167-173(Mar 1971).

Low-lying states of even-even nuclei, such as ^{224}Ra and ^{226}Ra, of negative parity and spheroidal asymmetry may play an important role in asymmetric fission of nuclei. In this study, the authors investigated the effect of shell structure on deformation of quadrupole (β_2) and octupole (β_3) types under restriction of axial symmetry. In choosing the octupole part of the deformed potential, anharmonic of type r^3Y_{30} was adopted. When dependence of the potential on the deformation is taken into account in order higher than the first, some deviation from results previously obtained may be expected. Detailed calculation has not yet been completed, but the possibility of occurrence of the octupole deformed nucleus is discussed. (JA)

5161 VALIDITY OF THE TALMI'S MASS FORMULA FOR SINGLE CLOSED SHELL NUCLEI. Lorazo, B.; Arvieu, R. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 49B: No. 3, 231-234(15 Apr 1974).

A quadratic mass formula proposed by Talmi for identical nucleons in an open and nondegenerate shell is discussed. Corrections coming from the breaking of generalized seniority are examined. (auth)

5162 QUENCHING IN THE BASIC πN AMPLITUDE FOR PION-NUCLEUS SCATTERING. Eisenberg, J. M. (Univ. of Virginia, Charlottesville). Phys. Lett.; 49B: No. 3, 224-226 (15 Apr 1974).

An upward shift of the 3,3 resonance energy in pion-nucleus scattering is discussed, which arises from the absorption of the transferred pion in the Chew–Low πN amplitude, when the πN system is embedded in the nuclear medium. (auth)

5163 ROLES OF ANTISYMMETRIZATION IN SCATTERING PROCESS AND INTERACTIONS OF COMPOSITE PARTICLES. Suzuki, Y. (Niigata Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1302-1311(Oct 1973).

The equation of the resonating-group method is divided into two parts in order to investigate the effects of the antisymmetrization in the composite particle scattering. The first part is essentially the same as the orthogonality condition model which describes the scattering by the direct potential on condition that the relative wave function is orthogonal to the forbidden states due to the Pauli exclusion principle. The second part is expanded in the number of nucleons exchanged through the antisymmetrization and is expected to be approximated only by a few terms which come from the exchange of relatively small number of nucleons. This treatment is an extension of the orthogonality condition model and is an approximation method to solve the resonating group equation which takes in the antisymmetrization exactly, for the case of the scattering of the heavy composite particles. (auth)

5164 ROTATION OF THE PLANE OF POLARIZATION OF γ-RADIATION BY HYPERFINE INTERACTION. Heusinger, R.; Kreische, W.; Lampert, W.; Reuter, K.; Roth, K. H.; Thomas, K. (Univ., Erlangen-Nuernberg, Ger.). Phys. Lett.; 49B: No. 3, 269-271(15 Apr 1974).

The orientation of the plane of polarization as well as the degree of linear polarization of γ-radiation is investigated in an external magnetic field. (auth)

5165 SUPERSONIC HEAVY-ION COLLISIONS. Wong, C. Y.; Welton, T. A. (Oak Ridge National Lab., TN). Phys. Lett.; 49B: No. 3, 243-245(15 Apr 1974).

An illustrative one-dimensional example of a supersonic heavy-ion collision reveals important features such as shock wave velocity, density increase, energy increase, heat energy produced and the Mach number at which dissociation of nucleons occurs. (auth)

5166 ENERGY DEPENDENCE OF ALPHA-PARTICLE AND HEAVY-ION OPTICAL POTENTIALS. Jackson, D. F.; Johnson, R. C. (Univ. of Surrey, Eng.). Phys. Lett.; 49B: No. 3, 249-252 (15 Apr 1974).

It is shown that the observed energy dependence of α-particle optical potentials can be understood in microscopic terms. General results which can be applied to other composite projectiles are obtained. (auth)

5167 INDUCED RADIATIVE TRANSITIONS OF INTERMEDIATE MOLECULES IN HEAVY ION COLLISIONS. Mueller, B.; Kent-Smith, R.; Greiner, W. (Univ., Frankfurt am Main). Phys. Lett.; 49B: No. 3, 219-223(15 Apr 1974).

Three types of transitions exists in intermediate molecules occurring in heavy ion scattering: spontaneous radiative, induced non-radiative, and induced radiative decay. The latter ones yield an asymmetric angular distribution for molecular x-rays with respect to the ion-beam axis. The experimental verification of this effect would furnish an experimentum crucis for both, the existence of molecular x-rays and the induced radiative transitions. (auth)

5168 IMPROVED RELATIVISTIC OBEP, TWO-NUCLEON AND INFINITE NUCLEAR MATTER DATA. Erkelenz, K.; Holinde, K.; Machleidt, R. (Univ., Bonn). Phys. Lett.; 49B: No. 3, 209-212(15 Apr 1974).

A momentum-space OBEP consisting of π, η, ρ, ω, ϕ, σ and δ-meson exchange is presented. Compared to a former paper (OBEP (I)) the cut-off description is refined and an attempt is made to use more realistic values of the coupling constants. The quality of the resulting phase shift fit and the deuteron data is good (χ^2/datum = 2.7) and comparable to OBEP (I). The nuclear matter data calculated in exactly the same way as in the case of OBEP (I) are improved (now 11.2 MeV at $k_F = 1.47$ fm^{-1} compared to 12.4 MeV at $k_F = 1.55$ fm^{-1} for OBEP (I)), since the saturation density is considerably lowered without losing too much binding. (auth)

5169 STUDIES OF ERROR DEPENDENCE ON DIFFERENT CONDITIONS OF PERFORMING MEASUREMENTS IN DETERMINATION OF PARAMETERS OF RADIOACTIVE DECAY LINES. Vishnevskii, I. N.; Babenko, V. V.; Latyshev, G. D.; Rudchik, A. T. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 2, 280-283(Feb 1974). (In Russian).

Relative errors of determining parameters of radioactive decay lines were studied by the method of mathematical simulation as dependent on different conditions of performing the experiment. When using multichannel analyzers, the errors of determining the line half-width were studied as dependent on the analyzer channel energy width. When measuring the spectra "at points", the errors of determining position of the line, its width and intensity were studied as dependent on the number of the measured points and on the time of each point measurement for long half-life and short half-life isotopes. (auth)

5170 EVALUATION OF NUCLEAR MATRIX ELEMENTS INVOLVING HARMONIC OSCILLATOR WAVE FUNCTIONS. Scott, C. K.; Singh, R. N. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 4, 324-329(15 Feb 1974).

A simplified form of the integral of products of harmonic oscillator wave functions is presented, with application to the evaluation of common nuclear matrix elements. (auth)

5171 AXIALLY ASYMMETRIC TWO-CENTER SHELL MODEL. Junker, K. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Atomkernenergie; 23: No. 1, 57-65(1974).

The two-center model developed by P. Holzer et al. is generalized to include axially asymmetric deformations. Volume conservation is done for that equipotential surface which coincides with the nuclear surface. In a second step the asymmetric model of M. G. Mustafa and U. Mosel is generalized to axially asymmetric distortions. The matrix elements of the Hamiltonian including a spin–orbit potential are given, using the eigenfunctions of the simple axially asymmetric two-center oscillator as basis functions. (1 figure) (auth)

5172 VALIDITY OF DWBA IN A THREE-BODY MODEL OF STRIPPING. Bouldin, D. P.; Levin, F. S. pp 949-952 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

It is shown that while DWBA produces reasonable angular distributions in the three-body model of stripping, it does not provide good agreement in detail. The implication for many-body reactions is that DWBA is not as accurate as the adiabatic approximation, a conclusion also confirmed by fitting experimental (p,d) data. (auth)

5173 THREE-BODY NATURE OF NUCLEAR REACTIONS INVOLVING SEQUENTIAL DECAYS. Hussein, M. S. pp 972-975 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

A three-body treatment of final-state resonance reactions is discussed. A system of three identical Bose particles interacting amongst themselves via two-body forces only is considered. The potentials associated with these forces are assumed separable for simplicity. Faddeev-like equations were set up relating three different amplitudes to each other. These amplitudes are the elastic, rearrangement, and the break-up amplitudes. The use of separable two-body interactions simplifies these Faddeev-like equations and renders them into a manageable set of coupled integral equations. One of the pairwise interactions can be turned off without jeopardizing any of the physics. The other two interactions are assumed to be such that one describes bound state and the other resonant scattering. To correct for the separable approximation of the potentials associated with the two-body interactions one merely adds a nonseparable, smoothly varying, function of momentum to the two-body amplitude corresponding to these potentials. After some formal manipulation a natural way to write down the break-up amplitude is found. (auth)

5174 FEW-NUCLEON PROBLEMS IN ASTROPHYSICS. Tombrello, T. A. pp 928-939 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (Ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

Three different situations in astrophysics in which few-nucleon reactions are important are considered. These are the central regions of main sequence stars like the sun; stellar atmospheres and the interstellar medium; and the extremely hot, dense regions that occur in a process like the "big bang" fireball. (auth)

5175 *COUPLING BETWEEN IAS AND GIANT DIPOLE* RESONANCE. Terasawa, T. (Australian National Univ., Canberra); Fujita, J. I. Nucl. Phys., A223: No. 3, 492-508(1974).

Recently the measurement of γ transitions to and from isobaric analog states has become an important tool for studying nuclear structure. In order to obtain information on the corresponding β decays from these experiments for heavier nuclei, possible theoretical corrections must be estimated carefully. The previous formalism for isobaric analog states is extended to cases including E1 γ transitions, and it is shown that the correction terms are small for the Pb region, but it is dangerous to believe that they are small for all nuclei. (3 figures, 1 table) (auth)

5176 ROTATIONAL ONE-PARTICLE STATES OF ODD NONAXIAL NUCLEI WITH MODIFIED MOMENTS OF INERTIA. Israilov, A. A.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 19: No. 3, 499-502(Mar 1974). (In Russian).

Excited states of odd nonaxial nuclei are calculated on basis of a Hamiltonian with modified moments of inertia in a nonadiabatic approximation. Strong violation of the level symmetry related to $\gamma = 30°$ is observed. (auth)

5177 TWO-STEP EFFECTS IN DEUTERON STRIPPING ON SPHERICAL NUCLEI. Luk'yanov, V. K.; Semenov, V. M.; Tseipek, Ya. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 583-594(Mar 1974). (In Russian).

In the adiabatic approximation a simple model of the nucleon two-step transfer is suggested for the deuteron stripping on spherical nuclei. The model is connected with virtual excitations of the lowest (phonon) levels of the initial and final nuclei. The spin-orbital interactions in the reaction channels are taken into account. The cross sections of the allowed and forbidden transfers, the polarization, the asymmetry and J-dependence of the cross sections are calculated. The problem of extracting of the C-factors, as a measure of collective components of the nuclear states, is discussed. The results are compared with experimental data. (auth)

5178 STRUCTURE OF GIANT DIPOLE RESONANCE IN DEFORMED SPHEROIDAL NUCLEI. Orlin, V. N. (Moscow State Univ.). Yadern. Fiz.; 19: No. 3, 521-528(Mar 1974). (In Russian).

Effect of coupling of dipole and quadrupole oscillations on the shape of the giant dipole resonance is considered for deformed spheroidal nuclei. The collective motion is described by means of a simplified nuclear Hamiltonian. The obtained energies and intensities of the dipole transitions coincide with the corresponding quantities, calculated previously, but differ essentially from those obtained in other previous work. The last is due to that in previous work, the functions are used as basis functions, that have incorrect boundary properties at $\gamma \to 0$. It is shown that interaction of dipole and quadrupole oscillations not only results in new resonances in the domain of the transversal maximum, but also causes a decrease of their widths. (auth)

5179 MASS NUMBER DEPENDENCE OF THE DENSITY OF $\frac{1}{2}^+$ STATES IN THE VICINITY OF THE NEUTRON BINDING ENERGY. Vdovin, A. I.; Voronov, V. V.; Malov, L. A.; Solov'ev, V. G.; Stoyanov, Ch. (Joint Inst. of Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 3, 516-520(Mar 1974). (In Russian).

In the framework of the semimicroscopic approach taking into account the energies of the one-quasiparticle and phonon components the mean distance D between the states with $I^\pi = \frac{1}{2}^+$ in spherical and deformed nuclei was calculated in the region $139 \leq A \leq 205$ at neutron binding energy B_n and 6.5 MeV. A rather good description of the density of $\frac{1}{2}^+$ state was obtained at neutron binding energy and a correct A dependence of the density. It is shown that the theory well describes the strong growth of D for the transition from deformed to spherical nuclei, the increase of D when approaching the magic nuclei and oscillations of D values in deformed nuclei. (auth)

5180 TARGET SPIN EFFECTS IN THE SCATTERING OF COMPOSITE PARTICLES. Clarke, N. M. (King's Coll., London). J. Phys., A (London); 7: No. 1, L16-L19(1 Jan 1974).

A recent optical-model analysis of ^{3}He elastic scattering data has found evidence of target spin effects. The possible causes of these effects are examined, and experiments are suggested which may reveal more information about the target spin effects. (1 figure) (auth)

5181 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS, MUNICH, GERMANY, AUGUST 27-SEPTEMBER 1, 1973. Volume 1. Contributed Papers. de Boer, J.; Mang, H. J. (eds.). New York; American Elsevier Publishing Company, Inc. (1973). 802p. (CONF-730815-P1). $43.50.

This volume contains a collection of the accepted one-page contributions submitted for the conference. Almost all papers are reproduced by photoreduction with only minor editing; major changes were necessary in those papers in which details in the original were too small to be legible after photoreproduction. The 722 papers in this volume can be divided by topic into 28 sections. (RWR)

For abstracts of individual sections see: 3315, 4291, 4494, 4563, 4892, 4966, 3967, 4968, 4996, 5016, 5033, 5053-5058, 5081, 5082, 5122, and 5182-5189.

5182 NUCLEAR INTERACTIONS. pp 1-36 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Thirty-six papers on this topic are presented. The following subjects are included: evaluation of the $pp\pi^0$ coupling constant from low-energy pp scattering; nucleon-nucleon potentials and scattering lengths; density-dependent effective interactions; meson-current corrections and binding energies in nuclear matter; nuclear binding energies using a modified form of the Sussex matrix elements; binding energies and charge form factors in three- and four-body systems; knowledge of nuclear forces from studies of few-body breakup reactions; three-nucleon calculations without explicit use of two-body potentials; the linked-cluster theorem in finite model spaces; calculations for the effective interaction; studies of effective interactions and noncentral forces in the O-Ne region. (RWR)

5183 SELFCONSISTENT THEORIES. pp 37-58 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Twenty-two papers on this topic are presented. Most of the papers deal with the Hartree-Fock method or variations on it. Masses and other ground-state properties are calculated. A microscopic description of anti-pairing and anti-stretching in sd- and pf-shell nuclei is given. ^{16}O, ^{28}Si, and ^{240}Pu are specifically treated. (RWR)

5184 NUCLEAR MODELS: SINGLE PARTICLE ASPECTS. pp 59-106 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Forty-eight papers on this topic are presented. The emphasis is on the particle-hole and shell models and their applications. In addition to papers of general application, nuclei ranging from ^{4}He to ^{211}Bi are treated specifically. The phenomena of weak coupling and on correlations are also examined. (RWR)

5185 NUCLEAR MODELS: CLUSTER STRUCTURE. pp 107-125 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Nineteen papers on this topic are presented. Aspects of the cluster nature of nuclei are discussed, from both structural and reaction points of view. While most of the papers deal with light nuclei, nuclei of intermediate mass are also addressed. (RWR)

5186 NUCLEAR MODELS: COLLECTIVE ASPECTS. pp 126-163 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Thirty-eight papers on this topic are presented. Rotational states, vibrational states, pairing interactions, and band mixing in nuclear structure are discussed. The generator-coordinate method, the Strutinsky method, the Wilets-Jean model of collective excitations, the angular momentum dependence of correlations in ground-state rotational spectra, nuclear moments of inertia, Coriolis coupling, and forbidden transitions are also treated. Nuclei specifically considered range from ^{19}F to ^{188}Re. (RWR)

5187 TRANSFER REACTIONS: THEORETICAL DEVELOPMENTS. pp 413-431 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Nineteen papers on this topic are presented. Subjects covered include the following: solvable model of stripping reactions; threshold effects; shell-model description of nucleon-transfer overlaps; a test of the DWBA; structure of hole states observed in direct reactions; many-body aspects of transfer reactions; method of vertex functions for 3- and 4-body systems; possible observation of the triangle graph; accuracy of the DWIA for breakup reactions; recoil effects; form factors; SU(4) partial level densities; neutron transfer into the continuum for heavy-ion reactions below the Coulomb barrier; DWBA analysis of transfer reactions; and application of the real Weinberg state method to unbound levels of ^{13}C formed by neutron scattering and (d,p) on ^{12}C. (RWR)

5188 TRANSFER REACTIONS: MULTISTEP PROCESSES. pp 484-492 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P1.

Nine papers on this topic are presented. Both experimental and theoretical studies of reaction mechanisms are included. The reactions studied range from (p,d) and (d,p) through (p,t) and (^{3}He,^{7}Be) to those induced by ^{18}O ions. The coupled-channel Born approximation is applied. (RWR)

5189 FISSION AND FUSION. pp 580-615 of Proceedings of the International Conference on Nuclear Physics. Vol. 1. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P1.

Thirty-six papers on these topics are presented, most of them having to do with fission. The kinetics of the fission process is an important area of inquiry, but subjects such as viscosity, potential energy surfaces, moments, fission barriers, and delayed fission are also discussed. Results on specific fission reactions are given, including ternary fission, electrofission, isomer fission, and fission with negative muons. The kinetics of heavy-ion fusion reactions is considered, and some results on the products obtained are presented. There is also a paper on a search for superheavy elements in nature by means of spontaneous fission. (RWR)

5190 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS, MUNICH, GERMANY, AUGUST 27-SEPTEMBER 1, 1973. Volume 2. Invited Papers. de Boer, J.; Mang, H. J. (eds.). New York; American Elsevier Publishing Company, Inc. (1973). 848p. (CONF-730815-P2). $43.50.

Separate abstracts were prepared for twenty-six of the papers in this volume. The other two have already appeared in NSA as papers 28: 26242 and 28: 28909. (RWR)

For abstracts of individual papers see: 2483, 4186, 4292, 4450, 4815, 4893, 4969-4972, 5059, 5060, 5083, 5084, 5099, 5123-5125, and 5191-5198.

5191 TRENDS IN NUCLEAR PHYSICS: WHAT CAN WE LEARN FROM HIGH-ENERGY INTERACTIONS? Goldhaber, M. (Brookhaven National Lab., Upton, NY). pp 13-20 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-.

Some general remarks are made on problems at the interface between nuclear and high-energy physics. Attention is focused on new developments associated with use of higher energies and new mesonic probes. The interactions of elementary particles with nuclei are considered, including stopping. Much of the paper is devoted to the topic of hypernuclei, defined to include not only lambda particles but also other strange particles such as Σ^-. Another area of interest is the virtual existence of Δ's in nuclei, in particular, the deuteron. Other areas of research where nuclear and high-energy physics interact are mentioned. (3 figures) (RWR)

5192 EFFECTIVE INTERACTIONS AND THE NUCLEON-NUCLEON FORCE. Baranger, M. (Massachusetts Inst. of Tech., Cambridge). pp 93-106 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

The methods by which an effective interaction (usable in nuclear structure calculations directly) is obtained from a given nucleon-nucleon force are discussed. The derivation of both an effective interaction suitable for the calculation of a closed-shell nucleus and one suitable for a shell-model calculation are included. The microscopic point of view is followed. (RWR)

5193 SELFCONSISTENT DESCRIPTION OF NUCLEI. Vautherin, D. pp 107-130 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

Different types of self-consistent calculations have been performed in recent years. The type discussed in this paper is the self-consistent calculations using effective interactions. This is emphasized because most of the new applications of self-consistent methods involve effective forces. The results obtained in nuclear structure calculations using effective interactions (obtained from a nucleon-nucleon force) are presented, along with the merits and limitations of these results. Quantities predicted by the Hartree-Fock method include equilibrium nuclear quantities and nuclear-deformation energy curves. (11 figures) (RWR)

5194 CLUSTER STRUCTURE. Arima, A. pp 183-213 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Despite the great success of the shell model in describing nuclear properties, interest in clusters has revived because heavy-ion reactions seem to transfer clusters selectively. The similarity between the Elliott SU_3 model [Proc. Roy. Soc., A245, 128 and 562 (1958)], the Wildermuth cluster model [Nucl. Phys., 7, 150 (1958); 9, 449 (1958/59)], and the Brink model [Proceedings of the International School of Physics, 'Enrico Fermi' 1965] is discussed. Alpha decay widths are then considered; these may provide a way to see the localized alpha clusters at the nuclear surface. Section headings are the following: Shell-model clusters and localized clusters, Alpha spectroscopic factors and alpha probability densities, and Alpha decay widths in ^{20}Ne. It is concluded that energy levels and electromagnetic transitions are reasonably well explained by shell-model calculations in a $0\hbar\omega$ space with renormalized interactions. Configuration mixing in a $0\hbar\omega$ space enhances the spectroscopic factors of clusters, whose upper limit is given by the SU_3 model. It seems, however, necessary to admix $2\hbar\omega$, $4\hbar\omega$, ... excited states in order to enhance the probability of finding alpha clusters at the nuclear surface region. Some alpha decay widths and transfer reaction cross sections indicate the importance of such admixture. (7 figures, 9 tables) (RWR)

5195 ROTATION-ALIGNED COUPLING SCHEME. Stephens, F. S. pp 367-399 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973). See CONF-730815-P2.

Consideration of nuclear states with high angular momentum suggests that a new coupling scheme is often important for states of very high spin. In this scheme the particle angular momentum, j, is quantized along the rotation axis of the nucleus. The objective of this paper is to define this (rotation-aligned) coupling scheme and to show why and where it is applicable in both the odd-A and even-even nuclei. It was suggested that backbending in the light rare earth region is just the intersection of the ground band with a rotation-aligned two-quasi-particle state composed of $i_{13/2}$ neutrons. (15 figures) (RWR)

5196 PRE-EQUILIBRIUM PROCESSES. Miller, J. M. (Columbia Univ., New York). pp 597-630 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

There are three readily discernible energy regions in the spectrum of a typical (p,xp) reaction at 62 MeV: a region up to about 10 MeV, which exhibits the shape expected for compound-nucleus reactions; a region above about 53 MeV, where the characteristic peaks corresponding to the excitation of particular low-lying states in the target by direct processes are seen; and a large region from 10 to 50 MeV, characterized by its lack of features. This featureless part of the spectrum is now called "pre-compound" decay. Presumably, there is a series of direct processes in the form of successive nucleon-nucleon collisions within the nucleus that are generated by the incident high-energy nucleon which results in the direct emission of some of the nucleons that participate in the consequent collisional cascade. The direct simulation of these intranuclear cascades was first carried out by Gold-

berger in two dimensions by the Monte Carlo technique. Other formalisms for investigating essentially the same physical model have been developed; these include the exciton model of Griffin and the solution of a suitably modified Boltzmann equation. These three formalisms are summarized and intercompared, with particular emphasis on recent advances, refinements, and criticism. (13 figures) (RWR)

5197 INTERMEDIATE STRUCTURE IN COMPOUND-NUCLEAR REACTIONS. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). pp 631-655 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

In recent years an attempt has been made to determine the more complex components of the nuclear wave function by investigating reactions in which two-step processes are important or (to attack the problem from the opposite direction) components for which the assumptions of statistical theory need to be modified. Some of these recent developments are reviewed. The natural extension of the one-step reaction is the two-step reaction. The most dramatic realization of the two-step process is the isolated doorway state resonance. Heavy-ion reactions and intermediate structure are then discussed. Attention is drawn to the use of asymmetry of angular distributions for determining the direct components of a reaction where fluctuations due to isolated doorway states are present. Statistical theory has successfully explained many aspects of heavy-ion reactions, and this theory is briefly considered. Precompound-nucleus reactions are then discussed in some detail, and the paper concludes with comments on some properties of the experiments on the fragmentation of the ^{16}O nucleus, in which ^{16}O nuclei at 2.1 GeV/nucleon strike a Be target. (13 figures) (RWR)

5198 CONFERENCE SUMMARY. Schiffer, J. P. (Argonne National Lab., IL). pp 813-837 of Proceedings of the International Conference on Nuclear Physics. Vol. 2. de Boer, J. (ed.). New York; American Elsevier Publishing Co., Inc. (1973).

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973). See CONF-730815-P2.

A fairly comprehensive summary of the conference is given. The high-lights of many of the invited papers are presented. Figures are presented on the following topics: anomalies on the $^{16}O + {}^{12}C \rightarrow {}^{28}Si^*$ system; energy-averaged cross sections for the $^{12}C + {}^{12}C \rightarrow {}^{20}Ne + \alpha$ reaction; angular distributions from the $^{48}Ca(^{14}N,{}^{13}C)^{49}Sc$ reaction at 50 MeV; energy spectra and angular distributions from the bombardment of ^{232}Th by ^{40}Ar; the double-humped fission barrier; moment of inertia of ground-state rotational bands of even isotopes of Dy, Er, Yb, and Hf; and spectra from inelastic electron scattering from ^{140}Ce. General comments on the state of physics are also made. (11 figures) (RWR)

5199 LEGENDRE SERIES AND A QUADRATURE FORMULA FOR ITS COEFFICIENTS. Delic, G. (Technische Hochschule, Darmstadt, Ger.). J. Comput. Phys.; 14: No. 3, 254-268(Mar 1974).

A quadrature formula which may be used to evaluate the coefficients of the Legendre series is presented. The formula is of more general interest in that it is a quadrature for a Legendre polynomial weight function. An example demonstrates the usefulness of this formula which is also relevant to the finite range distorted waves Born approximation method in nuclear physics. (auth)

5200 OFF-ENERGY-SHELL CONTINUATION OF THE $^1S_0$ TWO-NUCLEON TRANSITION MATRIX. Sauer, P. U. (Univ., Freiburg i. B.). pp 86-89 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The two-nucleon transition matrix T is closely related to experiment. Its on-shell part is given by the elastic scattering data; its pole, by the deuteron. The off-shell part of T is needed, e.g., for nuclear-structure calculations. However, direct experimental information on it does not yet exist. Thus, before T is used, its off-shell part has to be parametrized somehow. Usually, this is done by inventing a potential V which reproduces the known two-body data and simultaneously yields a guess on the off-shell behavior of T. But since T and not V is close to experiment, the off-energy-shell continuation directly in T, avoiding the detour to V, is the preferable procedure. This is done for T in the $^1S_0$ partial wave. The entire off-shell $^1S_0$ T is numerically obtained from a real symmetric function $\sigma(k,k_1)$. σ contains as much information as V. Equal value contours of σ for the Reid and Tabakin potential are calculated. At low energies they are independent of the shape of the interaction tail. Binding energies for ^{16}O and ^{18}O are constructed for various off-shell behaviors of σ, which is much easier to use than V. (INIS)

5201 WAVE FUNCTION MODELS OF THE TWO-NUCLEON T-MATRIX OFF THE ENERGY SHELL. Picker, H. S.; Redish, E. F.; Stephenson, G. J. Jr. (Univ. of Maryland, College Park). pp 82-85 of Few Particle Problems in the Nuclear Interaction. Slaus, I. (ed.). Amsterdam; North-Holland Publishing Company (1972).

From proceedings of the international conference on few particle problems in the nuclear interaction; Los Angeles, CA (28 Aug 1972).

The wave-function model of the $^1S_0$ two-nucleon T matrix half off the energy shell previously described by the authors has been extended to include fully off-shell T matrices. The fully off-shell T matrix is written as $t_0(p,k;s^2) = t_0(k,s;s^2) + [(s^2-p^2)/pk] \int_0^\infty dr \sin pr\, \Delta_0(k,r;s^2)$ where the $t_0(k,s;s^2)$ is a half-shell T-matrix element. The model is specified by choosing a set of phase shifts and a local potential tail beyond some matching radius. Matrix elements are calculated for p, k, and s ranging from 0.15 fm^{-1} to 1.8 fm^{-1} and compared to those of the Reid soft-core potential. The sensitivity of the results to the assumptions made in the model are examined. (INIS)

5202 QUANTUM MECHANICAL TREATMENT OF THE PENETRATION THROUGH A TWO-DIMENSIONAL FISSION BARRIER. Hofmann, H. (Univ. of Copenhagen). Nucl. Phys.; A224: No. 1, 116-139(1974).

The collective Hamiltonian is idealized by making a harmonic approximation for the motion perpendicular to the fission path. This is done within a properly defined set of coordinates. The frequency for the transverse oscillations depends on the fission coordinate which leads to a coupling between the two degrees of freedom. Its influence is discussed within the language of scattering theory. Using the Born approximation, formulas for the transmission amplitudes are deduced. These formulas are applied to a simple example. All calculations are done analytically, taking into account the variation of the inertia for the fission mode. (auth)

5203 PERTURBATION THEORY FOR THE EFFECTIVE INTERACTION IN NUCLEI. Schucan, T. H. (Schweizerisches Institut fuer Nuklearforschung, Zurich); Weidenmueller, H. A. Ann. Phys. (N. Y.); 76: No. 2, 483-509(Apr 1973).

Starting from a decomposition of the Hamiltonian H(x) of the nuclear many-body problem in the form $H(x) = H_0 + xV$, where H_0 is a shell-model Hamiltonian, V the residual interaction, and x a strength parameter, a general effective interaction W(x) is introduced describing the interaction of nucleons within a shell, and the associated effective operators $\hat{A}(x)$. Some properties of these operators are displayed. From a particular choice of W(x) the expressions introduced earlier by several authors are obtained. The convergence of the expansions for W(x) and $\hat{A}(x)$ in powers of x is investigated. It is shown that W(x) and A(x) are holomorphic in a domain of the complex x-plane including the point x = 0. With the help of a generalization of the von Neumann–Wigner noncrossing rule, the nature of the common singularity of W(x) and $\hat{A}(x)$ which is closest to the origin and thus defines the radius r_0 of convergence of the expansions of W and A is defined. It is shown that r_0 is unaffected by the cancellation of unlinked diagrams. A criterion of consistency is established, which shows that most of the practical calculations of W lead to results which are inconsistent with the definition of W. (auth)

5204 PERTURBATIVE BOSON EXPANSIONS TO ALL ORDERS FOR EVEN AND ODD NUCLEI. I. Formal Properties. Marshalek, E. R. (Univ. of Notre Dame, IN). Nucl. Phys.; A224: No. 2, 221-244(1974).

The boson expansion first proposed by Beliaev and Zelevinsky is augmented to include odd as well as even particle numbers. Closed forms, valid to all orders, are presented for the boson images of the basic linear and bilinear fermion operators, both with and without angular-momentum coupling. The physical subspace is extracted explicitly in an elementary manner. The formalism simultaneously deals with both density and pair vibrations, their mutual interaction, and the effects of coupling of an odd particle. (auth)

5205 PERTURBATIVE BOSON EXPANSIONS TO ALL ORDERS FOR EVEN AND ODD NUCLEI. II. Illustrative Applications. Marshalek, E. R. (Univ. of Notre Dame, IN). Nucl. Phys.; A224: No. 2, 245-261(1974).

The use of the perturbative boson expansion for even and odd systems developed previously is demonstrated with a general Hamiltonian involving effective particle-hole and particle-particle interactions. In particular, the leading-order corrections to the

RPA are studied. The formal equations of the theory of finite Fermi systems emerge in an elementary manner. Introduction of separable multipole forces permits comparison with the Copenhagen vibration-particle coupling model. The boson approach has the advantage of greater simplicity and a priori transparency as well as that of providing closed forms which sum all orders. (auth)

5206 CONNECTION BETWEEN THE GENERATOR COORDINATE METHOD AND BOSON EXPANSIONS FOR ODD-PARTICLE SYSTEMS. da Providencia, J. (Univ., Coimbra). Nucl. Phys.; A224: No. 2, 262-268(1974).

The generator coordinate method is used to derive a boson expansion for odd-particle systems which is equivalent to the Yamamura and Marshalek expansions. (auth)

5207 SCATTERING FROM A COMPLEX SYSTEM: EXPLICIT SOLUTION AND MULTIPLE SCATTERING EXPANSION FOR A TWO-BODY TARGET. Koch, J. H.; Walecka, J. D. (Stanford Univ., CA). Nucl. Phys.; B72: No. 2, 283-309(1974).

In analyzing the scattering of hadrons from many-body nuclear targets, either through the multiple-scattering expansion or an equivalent optical potential, there are many points of interest: the dependence on the elementary scattering amplitudes, the effects of a resonance between the projectile and one of the scatterers, the effects of off-shell propagation in the target (or equivalently, the role of overlapping scatterers), the dependence on the target wave-function, the role of multiple reflections between the target particles, and more fundamentally, the convergence of the multiple-scattering expansion itself. Some of these problems are investigated within the framework of target closure, or the "frozen-nucleus" approximation using separable potentials to parametrize the elementary interaction of the projectile with one of the target particles. Following Foldy and Walecka, an explicit solution to the scattering problem can be obtained. Here the simplest target system, two identical particles in an s-wave bound state, is considered. (auth)

5208 N-EMISSION IN μ^- CAPTURE WITH FERMI MODEL. Galindo, A. (Univ., Madrid); Pascual, P.; Pascual, R. An. Fis.; 68: No. 10-12, 275-279(1972).

The asymmetry parameters for the process of muon capture as a function emitted neutron energy are calculated. Relativistic cross sections are considered using the Fermi gas model. (tr-auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 3345, 3570, 3583, 3595–3597, 3604, 3620, 4027, 4118, 4124, 4416, 4442, 4489, 4490, 4924, and 5486.

5209 (AD-765487) APPLICATION OF ADJOINT DIFFERENCE AND SURFACE INTEGRAL METHODS TO SELECTED DEEP-PENETRATION RADIATION TRANSPORT PROBLEMS. Final Report. Robinson, J. C.; Stevens, P. N.; Hoffman, T. J. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Mar 1973. Contract DAAD05-71-C-0150. 47p. (NEUT-150-3; BRL-CR-98). NTIS $3.00.

A comparison of the surface integral and adjoint difference techniques is presented. The comparison is made from a brief theoretical development of each method and by the results obtained using each method for several radiation transport problems of the class of a target located in air (or air-ground interface) far removed from a point neutron source. Most targets considered thus far do not contain fissile materials; however, it is demonstrated that the calculational tools employed in this study are applicable to such targets. The theoretical considerations lead to the conclusion that an error is associated with the surface integral technique, but this error will probably be small for the class of problems considered herein. In contrast to this, the adjoint difference technique is exact. The numerical results presented agree with these predictions. (auth)

5210 (AD-766509) SAM-CE MONTE CARLO CALCULATIONS OF NITROGEN AND CARBON BALL INTEGRAL EXPERIMENTS. Final Report. Cohen, M. O.; Beer, M. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). 3 Aug 1973. Contract DNA001-73-C-0016. 42p. (MR-7033; DNA-3160-Z). NTIS $4.25.

The SAM-CE Monte Carlo computer code has been used to calculate the neutron and secondary gamma ray counting rates at detectors located near spherical samples of graphite and liquid nitrogen which are subjected to a monodirectional neutron beam. The detectors are placed at angles of 30, 50, and 125° to the initial neutron flight path. The calculated counting rates are compared with experimental results obtained by Gulf Radiation Technology. (auth)

5211 (AD-768042) ADDITIONAL ANALYSIS OF NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN CONCRETE USING THE SAM-CE MONTE CARLO CODE. Cohen, M. O.; Beer, M. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Sep 1973. Contract DNA001-73-C-0016. 43p. (MR-7035; DNA-3182-T). NTIS $3.00.

The SAM-CE Monte Carlo code has been used to analyze the time-dependent transport of neutrons and secondary gamma rays in a forty centimeter thick slab of concrete. Calculated counting rates and energy leakage spectra at a detector located behind the concrete slab, are compared with previous SAM-CE calculations involving older cross section sets. The results are also compared with similar experimental results obtained by Gulf Radiation Technology. (auth)

5212 (CONF-720724-P1, pp 34-46) SPATIAL ENERGY-DENSITY DISTRIBUTIONS AROUND ION PATH IN POLYMERS. Fain, J.; Monnin, M.; Montret, M. (Univ. de Clermont, Clermont-Ferrand, France). 1972.

From 8th international conference on nuclear photography and solid state track detectors; Bucharest, Romania (10 Jul 1972).

The spatial energy-density distribution around ion path in polymers during the first step of energy deposition (duration $\sim 10^{-13}$ s) was calculated. A δ-ray model was used. The δ-ray spectrum was calculated from binary encounter theory with the electron binding energy taken into account and low-energy ejected electrons (below 100 eV) included. About 30% of the energy is directly deposited by the ion very close to the particle's trajectory; the rest is carried away by δ rays, and the corresponding energy distribution is estimated from energy deposition data by low-energy electrons. (1 figure, 2 tables) (auth)

5213 (LUIP-CR-73-13) ENERGY DOSE CONCEPT APPLIED TO HEAVY ION TRACKS IN NUCLEAR EMULSION. Jacobsson, L.; Rosander, R. (Lund Univ. (Sweden). Fysiska Institutionen). Nov 1973. 25p. Dep. NTIS (US Sales Only). $4.25.

Experimental data on track widths in nuclear emulsion are compared with the theoretical distribution of the energy dose around the path of a moving ion. The dose distribution has been calculated following the formalism of the track formation theory developed by Katz and co-workers. The track widths have been estimated from light absorption profiles of heavy ion tracks. The profiles have been recorded with a nuclear track photometer with a narrow slit. The tracks studied were produced by stopping cosmic ray particles with the charges 6, 12, 18, 24, and 26. The measurements cover the residual range interval $0 < R \leq 1000$ μm, implying ion velocities below 0.33 c. Two types of emulsion with different sensitivity, Ilford G5 and Ilford K2, have been investigated. The measured track widths in K2 are quite well described theoretically, whereas regarding the measurements in G5 there is some disagreement between experimental and theoretical track widths. (auth)

5214 (ORNL-TM-4345) PHOTON SPECTRA FROM INDUCED ACTIVITY IN AN ORBITING SPACECRAFT. Alsmiller, R. G. Jr.; Chapman, G. T.; Wachter, J. W.; Barish, J. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 31p. Dep. NTIS $4.75.

The results of nucleon–meson and photon transport calculations are presented, and an estimate is given of the photon spectrum from the induced activity in a spacecraft orbiting the earth and periodically passing through the Van Allen proton belt. A simplified slab model of the spacecraft is considered, but a realistic time dependence of the proton flux per unit energy for the orbit assumed is used. Results are given for a variety of times (≤ 23.5 hours + 720 days) after the spacecraft has been in orbit. (auth)

5215 CONCEPT OF IN-DEPTH DOSE IN CURIE THERAPY. Lima Basto, E. Arq. Patol. (Lisbon); No. Special Suppl., 17-24 (Feb 1972). (In Portuguese).

The dose characteristics of α and β particles and γ radiation are briefly indicated. The development of dose concepts and units is outlined. Dose calculations are illustrated. (JSR)

5216 RADIATION AT DEPTH. Lima Basto, E. Arq. Patol. (Lisbon); No. Special Suppl., 7-15(Feb 1972). (In Portuguese).

The structure of the atom is briefly outlined. The radiations of the daughter products of Ra are tabulated. The characteristics of x rays and their absorption and scattering are discussed. The in-depth dose resulting from scattered and recoil radiation is evaluated. (JSR)

5217 SPECIFICATION OF UNITS FOR NATURAL URANIUM AND NATURAL THORIUM. Nucl. Safety; 15: No. 2, 196-197 (1974).

The NCRP recommends that the use of the special curve for natural uranium previously proposed be discontinued and that mass units be used to define quantities of natural uranium as they appear in the specification of MPC and MPBB values. The same recommendation and reasoning apply to the case of natural thorium. (ERB)

5218 DOSE-RATE AND SHIELDING CALCULATIONS FOR PROMETHIUM METAL AND OXIDE SOURCES. Van Tuyl, H. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 85-138 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Promethium is of interest primarily because of the low dose rate from well-designed promethium sources. The choice and thickness of shielding materials must be carefully considered to assure that full advantage is obtained from the unique properties of promethium. Most fission products emit gamma radiation which is highly penetrating, and which requires heavy shielding. Although strontium and its daughter yttrium are both pure-beta emitters, they suffer from the same disadvantage because of the inner bremsstrahlung accompanying beta decay and the large amount of external bremsstrahlung produced when the beta particles are absorbed in the source material and its shield. Bremsstrahlung radiation is just the same as gamma radiation except for its method of formation. The maximum energy of bremsstrahlung from a strontium source is 2.27 MeV (from the yttrium daughter), with the effective energy being about 1.5 MeV through thick shields. Promethium-147, however, has a maximum bremsstrahlung energy of only 0.225 MeV and no appreciable gamma radiation. Most of the ionizing radiation from promethium sources is the low-energy beta from ^{147}Pm. This is easily absorbed by a thin layer of virtually any shield material. The bremsstrahlung radiation from ^{147}Pm is more penetrating than the betas, but is of sufficiently low energy to be easily attenuated by shields of high atomic number. Thus, much lighter shields can be used to reduce the radiations from ^{147}Pm to a very low level. Other promethium isotopes, particularly ^{146}Pm and ^{148m}Pm, are

similar to the gamma-emitting fission products. An appreciable fraction of their decays result in higher-energy gammas so that their radiations are not easily attenuated. Thus, promethium dose rate and shielding calculations are concerned with high-energy gamma radiations as well as lower-energy gammas, bremsstrahlung, and beta radiation. Accurate information on the dose rate from promethium sources is required for optimizing designs of devices using promethium. Often a thin shield is adequate for reducing the dose rate to a negligible level, provided the correct shield material is chosen. Shielding design for the radiations from ^{147}Pm requires careful attention to the nature and effects of low-energy radiation, which depends strongly on the material used for shielding. Thus, shielding calculations for promethium cannot always be made with good accuracy using methods that are suitable for most other radionuclides. A basic understanding of the shielding process is required to appreciate fully the differences between ^{147}Pm and other fission products. (auth)

5219 INTERMEDIATE NEUTRON-INDUCED SLOW RECOIL PARTICLES APPLIED IN RADIOBIOLOGY. Bergman, R. O. (Uppsala Univ.). pp 83-95 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Neuherberg, F. R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Besides a knowledge of fundamental biological aspects of the interaction between slow particles and critical biopolymers, a knowledge of intermediate neutron-tissue interaction is necessary for health hazard estimation of, e.g., neutron fields outside reactor shields and for application of neutron capture therapy. Intermediate energy neutrons (0.1-30 keV) interact with tissue-equivalent matter predominantly by elastic collision, inducing slow recoil particles (with kinetic energies less than 30 keV), about 90% of which are hydrogen recoils. Even in comparison with the energy dissipation by ionization and excitation, atomic collisions between such slow particles and molecularly bound atoms are important events for the stopping of the recoil. Direct irradiation with slow protons of the cell nucleus is impossible because the range of slow particle recoils is very small relative to the linear dimensions of a typical cell. However, intermediate neutrons induce slow particles rather homogeneously at considerable depth in tissue. Technical problems have prevented production of sufficiently intense intermediate energy neutron fields for radiobiological applications without a dominating background of mainly fast neutrons, although, in principle, intense neutron beams of 24 keV could be produced if a suitably designed reactor facility were available. A technique was developed employing a proton accelerator, making possible the application of intermediate neutrons of mean energy 8 keV at dose rates of at least 10 rad/h completely without fast neutron contamination. Neutrons are produced in the $^{7}Li(p,n)^{7}Be$ reaction by protons less than 20 keV above the reaction threshold (1881 keV). A neutron-moderating body is placed in front of the Li target. Because neutrons emanating from the Li target are confined to forward directions, there exist positions for the irradiated object that only can be reached by neutrons scattered in the moderator. The neutron energies in such secondary fields are much lower than in the primary neutron field from the Li target. In addition, attenuation of photons associated with the interaction of proton and target can be performed without simultaneous decrease in the neutron flux density at object exposure positions. (auth)

5220 NEUTRON DOSIMETRY AND SPECTROMETRY METHODS USED IN CELL MUTATION EXPERIMENTS. Holt, P. D.; Boot, S. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 109-118 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Neuherberg, F. R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

The dosimetry and spectrometry methods used in the experiments on mutagenesis in cultured mammalian cells described in an accompanying paper are described. Absorbed dose is measured by two methods: acetylene and carbon dioxide-filled ionization chambers; and by calculation from the fluence measured with fission chambers. Starting from measurements of the neutron spectrum an existing computer program is used to calculate kerma in tissue and the ionization in acetylene and carbon dioxide for unit neutron fluence. Thus the neutron fluence can be obtained from the ionization chamber currents and compared with that given by the fission chamber, and the absorbed dose in tissue can be obtained from the fluence. The possible effects of wall absorption and variation of the effective center of the ionization chambers with neutron energy have to be considered. From ^{235}U fission chamber measurements as a function of distance from the target, with the chamber bare, in cadmium or in boron it is possible to estimate separately the components of scattered radiation produced in the target and from the walls of the room. Results for 14-MeV neutrons are compared with values obtained from a Monte Carlo diffusion calculation. Spectrometric measurements in the energy range 2 to 14 MeV have been made on the neutron from a thick water-cooled beryllium target bombarded with deuterons at 1.8, 4.5 and 11 MeV, and for (d,d) neutrons, using a surface barrier silicon diode with a thin hydrogenous radiator; the results are compared where possible with published spectra. Work is in progress on the measurement of the spectra below 2 MeV using a small spherical helium-3 proportional counter. (auth)

5221 BIOMEDICAL PROPERTIES OF PIONS. Fritz-Niggli, H. (Univ., Zurich). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 1, 87-97(Jan 1974). (In German).

The investigation of the biological properties of negative pions is of interest for the following reasons: Negative pions may prove to be a useful tool in cancer therapy, and their application in studies on the radiation hazards to man from different types of radiation and in basic research has shown promising results. Since only pions of low intensity have been available sofar for these studies, the theories developed still have to be verified by experimental results, although part of them have been confirmed approximately. When studying the absorption of the pions by biological matter, the following radiobiological facts have to be taken into account: the low OER, the gain factors, and the time-dependent distribution of the radiation dose. Up to date, only a few reaction systems have been investigated, such as mice spermatogonia, roots of Vicia faba, reversions of mutants of Saccharomyces cerevisia, human kidney cells, etc. Pre-clinical experiments, however, under the same conditions as those to be probably applied later on in clinical therapy, still have to be performed, and are absolutely necessary. In vitro and in vivo investigations with cell systems are planned to be carried out in the near future. First substantial results have already been achieved in basic research, where it has been possible e.g. to clarify to a large extent why the radiation effects are determined by the LET and environmental factors such as the oxygen content. Further experiments for the study of basic processes (ESR studies) and biological effects in embryonic and genetic systems will follow. (GE)

5222 TISSUE-AIR RATIO, PEAK SCATTER FACTOR AND CONSISTENCY. Henry, W. H. (National Research Council of Canada, Ottawa). Phys. Med. Biol.; 19: No. 1, 43-50(Jan 1974).

Attention was drawn to the contribution from scattered photons to the reference quantity for tissue/air ratio. Consistency between tissue/air ratio and peak scatter factor was discussed. The magnitude of possible discrepancies was estimated. Means by which consistency could be restored were suggested. (auth)

5223 NEUTRON-ISAIAH 40:21. The 13th Douglas Lea Memorial Lecture. Martin, J. H. (Dundee Univ., Eng.). Phys. Med. Biol.; 19: No. 1, 1-18(Jan 1974).

Aspects of neutron dosimetry comprising neutron interactions with tissue elements and the complications of these for the measurement of absorbed dose, the penetration of neutrons and the determination of dose in tissue masses, and the interaction with the molecules of tissue of the heavy ions set in motion by neutrons, were reviewed. (UK)

5224 EFFECTS OF THE RADIATION AT THE ENTRANCE POINT OF A NEGATIVE π-MESON BEAM. Winston, B. M.; Berry, R. J.; Berry, D. R.; Reading, D. H. (Churchill Hospital, Oxford). Brit. J. Radiol.; 47: No. 555, 201-203(Mar 1974).

The effects were studied of negative π-meson beam radiations on the roots of Vicia faba at the entrance point of the beam from air into a perspex water tank phantom. Eighteen groups of 12 beams each were used, giving 4 dose points each under aerobic of hypoxic, plateau or surface conditions, together with 2 control groups. The results showed an inconsistency in that both the OER and the RBE increased from plateau to surface. (UK)

5225 AVERAGE ABSORBED DOSE IN THIN ABSORBERS. McDavid, W. D.; Waggener, R. G. (Univ. of Texas, San Antonio). Phys. Med. Biol.; 19: No. 1, 107-108(Jan 1974).

ICRU Report 17(1970) contains the following expression for the average absorbed dose, $\bar{D}$, within a thin layer of thickness x, of a material having a density ρ, and a weighted mean mass energy absorption coefficient μ_{en}/ρ, for a heterogeneous beam of incident fluence ϕ $\bar{D} = \phi[1 - \exp(-\bar{\mu}_{en}x)]/\rho x$. For a monoenergetic beam, the expression becomes $\bar{D} = \phi[1 - \exp(-\mu_{en}x)]/\rho x$. It is pointed out that the expression is not formally correct. The fraction of energy absorbed is not $1-\exp(-\mu_{en}x)$ but (μ_{en}/μ) $[1 - \exp(-\mu x)]$ where μ is the linear attenuation coefficient for the absorber. The error arises from assuming that partial coefficients such as μ_{en} may be treated in the same way as the total attenuation coefficient μ. (UK)

5226 EASY WAY TO CALCULATE THE MEAN LENGTH OF TRAJECTORIES THROUGH BODIES OF GIVEN SHAPE. Zimmer, K. G. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 25: No. 3, 313(Mar 1974).

Simple methods of calculating the mean length of trajectories through bodies of given shape are briefly reviewed. (UK)

5227 CALCULATION OF THE EFFECTIVE ATTENUATION FACTOR OF γ-RADIATION IN A MICROSCOPICALLY INHOMOGENEOUS MEDIUM. Shmonin, L. I.; Potrebenikov, G. K. Sov. J. At. Energy (Engl. Transl.); 34: No. 4, 351-352(Apr 1973).

Translated from At. Energ. (USSR); 34: No. 4, 284(Apr 1973).

A method is shown for calculating the effective attenuation factor for γ-radiation in a homogeneous continuous medium in the form of a barrier with plane boundaries which contains occlusions of another material randomly distributed throughout its volume. The fraction of the volume occupied by the occluded material is small ($V \ll 1$). A plane unidirectional source of radiation was chosen. The behavior of the effective attenuation factor of γ-rays was studied as a function of the size of the occlusions, their shape, and orientation relative to the direction of propagation of the γ-rays. (MHR)

5228 DEPTH DISTRIBUTION OF ENERGY DEPOSITION BY ION BOMBARDMENT. Manning, I.; Mueller, G. P. (Naval Research Lab., Washington, DC). Comput. Phys. Commun.; 7: No. 2, 85-94(Feb 1974).

The code E-DEP-1 calculates the distribution of energy deposited into elastic collisions for a beam of heavy ions coming to rest in an amorphous target material of up to six atomic components. (auth)

5229 SCATTERING OF SLOW ELECTRONS FROM MOLYBDENUM MONOCRYSTALS. Artamonov, O. M.; Bolotov, B. B.; Kremkov, M. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 12, 2495-2498(Dec 1973). (In Russian).

The change in the energy loss spectrum and of the intensity of the maximum of secondary and elastically reflected electrons during adsorption of N_2, H_2, and residual gases on the surface of the (100) face of Mo is studied. It is shown that in conjunction with control of work function, these characteristics can give information on the state of the surface. (tr-auth)

Radiation Protection Standards

Refer also to abstracts 3597, 3601, 3696, 4991, 5694, and 5701.

5230 DEFINITION OF T IN THE NSD EQUATION. Orton, C. G.; Ellis, F. (New York Univ.). Brit. J. Radiol.; 47: No. 555, 200-201(Mar 1974).

Brief reply is made to criticism of the authors' redefinition of overall treatment time (B. J. Radiol., 46, p 529-537, (1973)). The time T for N fractions is defined as the interval between the first and (N + 1)th fractions, rather than the interval between the first and Nth fractions. (UK)

5231 RADIATION-PROTECTION ACTIVITIES OF THE BUREAU OF RADIOLOGICAL HEALTH. DeVore, R. T. (Dept. of Health, Education, and Welfare, Washington, DC). Nucl. Safety; 15: No. 2, 185-190(1974).

The Bureau of Radiological Health of the Department of Health, Education, and Welfare has numerous responsibilities regarding the limitation of man's exposure to ionizing and nonionizing radiations. Many of the Bureau's activities in 1972 in discharging these responsibilities are summarized. Included herein are brief reports on the Bureau's work in the following areas: studies of diagnostic x-ray exposures, development of x-ray-machine safety standard, x-ray-user training and education, development of laser and industrial x-ray standards, development of microwave-oven standard, enforcement activities, improved protection in the handling of radioactive materials, and research on biological effects. (auth)

5232 SOME ASPECTS OF RADIOLOGICAL PROTECTION IN POLAND AND THE ACTIVITY OF THE CENTRAL LABORATORY FOR RADIOLOGICAL PROTECTION (CELOR). Wardaszko, T. (Central Lab. for Radiological Protection, Warsaw). Izotoptechnika; 17: No. 2, 62-69(Feb 1974). (In Hungarian).

The organization of radiological protection in Poland, and groups of the CELOR and their tasks are described. (auth)

Radiation Source Calibration and Standardization

5233 IMPROVEMENT OF THE RADIATION CHARACTERISTICS OF ENERGY-SOURCE PROMETHIUM. Sheppard, J. C. (Washington State Univ., Pullman). pp 139-149 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

For many applications, "normal" promethium is an excellent energy-source material, but for some biomedical uses the radiation dose rate, which comes from the presence of 0.3 to 4 ppM of ^{146}Pm, may be excessive. Attempts to reduce the radiation dose rate from promethium sources to levels acceptable for biomedical applications by the transformation of ^{146}Pm to ^{147}Pm by neutron capture are discussed. The sources of gamma radiation emanating from promethium energy sources are described briefly. The physical basis for the reduction of the ^{146}Pm content and hence the gamma dose rate of the promethium energy source are discussed. An attempt to reduce the ^{146}Pm content in promethium energy-source material by neutron irradiation in one of the Hanford K reactors is described; similar irradiations in a Savannah River Laboratory reactor are also described. The results of the Hanford and Savannah River experiments and methods for further reducing the ^{146}Pm content in energy-source promethium are discussed. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 4817, 4830, and 5218.

5234 (CONF-740424-2) MATERIALS INFORMATION IN THE RADIATION SHIELDING INFORMATION CENTER. Maskewitz, B. F.; Trubey, D. K.; Roussin, R. W. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. 10p. Dep NTIS $4.00.

From materials information programs meeting; Gaithersburg, Maryland, USA (16 Apr 1974).

The Radiation Shielding Information Center (RSIC) established, in 1962, serves the shielding community by collecting, organizing, processing, evaluating, packaging, and disseminating information mainly related to reactor and weapons radiation. The scope includes the physics of interaction of radiation with matter, radiation production, transport and energy deposition, radiation detectors and measurements, engineering design techniques, shielding materials properties, computer codes useful in research and design, and shielding data compilations. This information is analyzed, evaluated, synthesized, and repackaged in a form more authoritative, timely, and useful. Promoting exchange and improvement of nuclear data, computer codes, and radiation transport information, RSIC provides strong support for the technology areas of its sponsors. The goal is to save time and prevent duplication of effort, to advance the state-of-the-art, to increase the value and content of information by correlating it with other information, and to implement government information-dissemination policy. Materials information is an integral part of all information in the subject areas covered by the Center. (auth)

5235 HALF-VALUE THICKNESS MEASUREMENTS OF ORDINARY CONCRETE FOR NEUTRONS FROM CYCLOTRON TARGETS. Butler, H. M.; Wallace, K. M.; Fulmer, C. B. (Oak Ridge National Lab., TN). Amer. Ind. Hyg. Ass. J.; 35: No. 4, 234-237(Apr 1974).

Half-value thicknesses of a wall of ordinary concrete bricks were determined for fast neutrons emitted from a variety of cyclotron beam-target combinations. The neutrons used in the study were produced at the Oak Ridge Isochronous Cyclotron by bombarding thick targets of carbon, aluminum, copper and tantalum with beams of protons, deuterons, alpha particles and carbon ions. Attenuated and unattenuated dose rate measurements of these neutrons were made at an 80 cm thick concrete block wall which served as one side of the target room where the irradiations occurred. The ratios provided by these shielded and unshielded dose rate measurements were translated into half-value thicknesses. (auth)

5236 PRACTICAL RADIATION PROTECTION CONSIDERATIONS. Howell, W. P. (Westinghouse Hanford Co., Richland, WA). pp 177-190 of Promethium Technology. Wheelwright, E. J. (Ed.). Hinsdale, IL; American Nuclear Society (1973).

Although promethium has a large number of known isotopes (at least 15 have been identified), only three are common enough to be of interest to the applied health physicist. These three isotopes are ^{146}Pm, ^{147}Pm, and ^{148}Pm, all of which are found in fission-product wastes from nuclear reactor fuels. Of the three, ^{147}Pm is the most significant, because of relative abundance in fission-product wastes, and moderately long half-life. Promethium-147 is essentially a pure-beta emitter, emitting particles of E_{max} 0.225 MeV. Because of the relatively low energy, shielding of the beta particles is fairly simple. However, like other beta emitters, ^{147}Pm will generate bremsstrahlung. The bremsstrahlung requires appreciable shielding for handling multi-curie sources. Because of the relatively large permissible body

burden of ^{147}Pm (60 μCi with bone as the organ of reference), the relative hazard from internal deposition cannot be directly equated with highly radiotoxic elements such as plutonium. However, the high specific activity (~928 Ci/g) requires comparable confinement and related control measures to minimize the possibility and degree of internal deposition. The applied health physics aspects of work with promethium are reviewed. (auth)

5237 DISTRIBUTION OF NEUTRONS IN WORKROOMS AT NUCLEAR INSTALLATIONS. Andreeva, L. S.; Savinskii, A. A.; Filyushkin, I. V. Sov. J. At. Energy (Engl. Transl.); 34: No. 4, 353(Apr 1973).

Translated from At. Energ. (USSR); 34: No. 4, 285(Apr 1973).

Rather simple relationships are described from which one can obtain the characteristics of a field of neutrons scattered by the floor, walls, and ceiling of a one-room experimental hall. The given relationships were obtained as a result of measurements of the scattered-neutron field using the many-sphere spectrometry method in three experimental halls of different sizes, and also based on published data on the neutron albedo. (MHR)

PHYSICS (THEORETICAL)

Refer also to abstracts 4589, 4642, and 5292.

5238 (JAERI-M-5349) GENERALIZED HARTREE APPROXIMATION AND INTEGRAL EQUATIONS FOR CORRELATIONS IN QUANTUM FLUIDS. Chihara, J. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 72p. NTIS (US Sales Only).

With the use of Mori's continued-fraction method and by taking the collisionless approximation and assuming the vertex part in Dyson's equation to depend only on the momentum transfer Q, a generalized Hartree equation and the density–density response function $\chi_Q(\omega)$ are obtained in terms of the density–density canonical correlation χ_Q. This generalized Hartree equation contains the self-energy effect through the effective interaction and the streaming term. On the basis of this equation, the direct correlation function and the Ornstein-Zernike relation in a classical fluid are extended to the case of a quantum fluid. These results give a generalization of the Hohenberg-Kohn-Mermin theory for a nonuniform electron gas applicable to a quantum fluid and also give an extension of the Percus method for deriving equations for the radial distribution function g(r) in such a way as to treat a quantum fluid. By applying this method to a neutral quantum fluid, quantal versions of the Percus-Yevick and the hypernetted chain equations are derived. For a charged quantum fluid (electron gas), new integral equations are obtained by dividing an interatomic potential into strong short-range and slowly-varying long-range parts, and these equations give the compressibility sum rule taking into account the role of the short-range part of the potential in a similar way as Landau's Fermi-liquid theory. (auth)

General

5239 (INP-853) STRICTLY ONE-PARTICLE INTERPRETATION OF NONLINEAR WAVE EQUATIONS. Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 5p. Dep. NTIS (U. S. Sales Only) $4.00.

A consistent strictly one-particle interpretation of all nonlinear wave equations is proposed. In the proposed scheme all these equations are trivially soluble. (auth)

5240 (MATSCIENCE-76, pp 269-274) REGULARIZATION OF SINGULAR OPERATORS. Shankara, T. S. (National Aeronautical Lab., Bangalore, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The regularization of singular operators that occur in quantum theory is considered in terms of generalized functions. (JFP)

5241 MATHEMATICAL FORM OF de BROGLIE'S CYCLICAL ACTION INTEGRAL. Mucci, J. F. (Oxford Univ.). Found. Phys.; 4: No. 1, 91-95(Mar 1974).

Mathematical expressions for the entropy S, the average information gained per trial ($\bar{I}$) from information theory, and the de Broglie cyclical action integral A from his reinterpretation of wave mechanics are shown to be similar. The importance of this observation in an understanding of S and $\bar{I}$ is considered. Furthermore, the similarity in the mathematical form of these functions indicates a possible route to further interpretation of de Broglie's A and the nature of his "hidden thermostat". (auth)

5242 CORRELATIONS WITHOUT JOINT DISTRIBUTIONS IN QUANTUM MECHANICS. Cartwright, N. (Stanford Univ., CA). Found. Phys.; 4: No. 1, 127-136(Mar 1974).

The use of joint distribution functions for noncommuting observables in quantum thermodynamics is investigated in the light of L. Cohen's proof that such distributions are not determined by the quantum state. Cohen's proof is irrelevant to uses of the functions that do not depend on interpreting them as distributions. An example of this, from quantum Onsager theory, is discussed. Other uses presuppose that correlations between p and q values depend at least on the state. But correlations may be fixed by the state even though the distribution varies from one ensemble to another represented by that state. Taking covariance as a measure of correlation, it is shown that the different commonly used joint distributions yield the same correlations for a given state. A general characterization is given for a family of distributions with this same covariance. (auth)

5243 FUZZY SETS IN THE THEORY OF MEASUREMENT OF INCOMPATIBLE OBSERVABLES. Prugovecki, E. (Univ. of Toronto). Found. Phys.; 4: No. 1, 9-18(Mar 1974).

The notion of fuzzy event is introduced in the theory of measurement in quantum mechanics by indicating in which sense measurements can be considered to yield fuzzy sets. The concept of probability measure on fuzzy events is defined, and its general properties are deduced from the operational meaning assigned to it. It is pointed out that such probabilities can be derived from the formalism of quantum mechanics. Any such probability on a given fuzzy set is related to the frequency of occurrence within that set of points in a random sample, where the sample points are themselves fuzzy sets obtained as outcomes of measurements of, in general, incompatible observables on replicas of the system in the same prepared state. (auth)

5244 CORRESPONDENCE PRINCIPLES OF QUANTUM MECHANICAL OPERATORS. Gruber, G. R. (New York Academy of Sciences, NY). Found. Phys.; 4: No. 1, 19-22(Mar 1974).

Various correspondence principles were previously described in connection with Weyl, Born–Jordan, and symmetrized ordering of quantum mechanical operators. An interesting comparison between the aforementioned ordering process and previous prescriptions is made. (auth)

5245 REMARKS ON CONTEMPORARY WAVE MECHANICS. Haas, A. (Central Research Lab. for Metrology, Budapest). Magy. Fiz. Foly.; 21: No. 4, 329-334(1974). (In Hungarian).

Interpretation of wave mechanical concept aroused the criticism of physicists of the caliber of Einstein and de Broglie. Von Neumann demonstrated mathematically that the probability interpretation of the Ψ wave is the only possible one. Most difficulties are encountered in the consideration of the wave-matter interaction. An attempt is made to replace the classical field theory of wave mechanics with thermodynamic concepts of the field theory. The particle-wave duality of microphenomena is explained on the basis of the particle-wave symmetry. Macroscopic phenomena due to microparticles, such as light, may be characterized by means of phenomenological currents. The thermodynamic phenomenological interpretation of macroscopic currents renders it unnecessary to consider quantitatively the position of individual microparticles on the basis of statistical or probability principles. (TTT)

5246 ELEMENTS OF GROUP THEORY FOR PHYSICISTS. Joshi, A. W. New York; John Wiley and Sons, Inc. (1973). 324p. $5.95.

The topics discussed cover abstract group theory, Hilbert spaces and operators, representation theory of finite groups, continuous groups and their representations, group theory in quantum mechanics, crystallographic and molecular symmetries, and group theory in solid state physics. (JFP)

5247 MORE ON THE THOMAS PRECESSION IN SPECIAL RELATIVITY. Aranoff, S. (Univ. of the Negev, Beer Sheva, Israel). Lett. Nuovo Cim.; 9: No. 15, 603-606(13 Apr 1974).

To clarify the subject of the Thomas precession, the following is explicitly shown, both quantum-mechanically and classically: Let an object have angular momentum S' about its body axis (spin), and undergo orbital motion in the (x-y)-plane of an inertial frame A. Viewed from A, the spin will precess. The orbital angular momentum will precess in the opposite sense, so that the total angular momentum remains constant. (LBS)

5248 EXPERIMENTAL TEST OF THE EPR PARADOX. Faraci, G.; Gutkowski, D.; Notarrigo, S.; Pennisi, A. R. (Univ., Catania, Italy). Lett. Nuovo Cim.; 9: No. 15, 607-611(13 Apr 1974).

It is suggested that Compton scatterers be used to analyze the polarization correlation of the two photons coming from the annihilation of positron-electron pairs in the singlet state as a test of the EPR paradox. (LBS)

5249 THEORY OF TRANSITION RADIATION DURING PASSAGE OF CHARGED PARTICLES THROUGH A BOUNDARY OF ARBITRARY FORM. Ter-Mikaelyan, M. L.; Bagiyan, R. A. (Inst. of Physical Research, Erevan). Dokl. Akad. Nauk Arm. SSR; 55: No. 1, 32-35(1972). (In Russian).

Formulas are derived for the intensity of radiation resulting from the passage of charged particles through a boundary of any form. (JSR)

5250 INDETERMINISM, TIME ARROW, AND PREDICTION. Belinfante, F. J. (Purdue Univ., Lafayette, IN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 157-177(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

Life in general, and man's memory in particular, determine a preferred direction in time ("time arrow"). It is made plausible that the time direction in which the entropy increases is this same time arrow. In quantum theory, wave functions describe not real (single) physical systems, but ensembles of systems. Reduction of wave packets corresponds to treating a system as a member of a new ensemble. Similarly, splitting an electromagnetic field into IN-field plus retarded field, or into OUT-field plus advanced field, corresponds to different ensembles describing a scattering on which only partial information is available. The desire to ascribe a source to any light observed is the reason for usually preferring retarded fields over advanced fields. Independent of the fact that retardation of light waves is shown experimentally by Fizeau's measurement of the velocity of light. Afterthought one shows that an eye-object interaction by advanced fields would violate the second law of thermodynamics. This would relate the time arrow of electromagnetism to the one of life. A puzzle remains when this is applied to light traveling between stars and interstellar dust. The time arrow of cosmology (time direction of expansion of the universe) is sometimes related to the time arrow of life by an extension of Olbers' paradox. An example worked out in afterthought two shows that this generalization of Olbers' paradox is not justified. Afterthought three contains some speculations about possible correlations between the time arrows of cosmology and of life. The time arrow of quantum theory is determined by the fact that quantum theory in general predicts future probabilities, and that it can retrodict (postdict) probabilities of the past only under specific conditions that often are not satisfied. This asymmetry becomes more understandable when quantum theory is applied to sequences of nonideal (irreproducible) measurements separated by the use of gadgetry that prepares chosen initial conditions for the next measurement. The entering here of choice indicates a relation between the mind with its built-in time arrow, and the choice of the ensembles to which quantum theory then is applied objectively. (auth)

Quantum Field Theories

Refer also to abstracts 4322, 4603, 4608, 4652, 4728, 5292, 5297, 5301, 5303, 5306, and 5321.

5251 (MATSCIENCE-76, pp 83-102) GEOMETRIZATION OF CREATION FIELD AND ITS PHYSICAL INTERPRETATION. Mariwalla, K. H. (Inst. of Mathematical Sciences, Madras). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

An outline of a theory is presented that provides for creation of matter and avoidance of singularities and has the following features. There is no ad hoc creation field as an additional parameter. Instead it has a purely geometrical origin. During the process of creation (destruction) the energy-momentum tensor changes and thus there is a spontaneous breakdown of symmetry, though the geometry continues to be Riemannian and the system of geodesics is unaffected. The triggering mechanism of creation thus has overtones of Goldstone modes. On the microscopic level a possible candidate for the Goldstone particle responsible for creation is the tachyon. To avoid possible contradiction with special relativity it is proposed that tachyons interact only in the neighborhoods of collapse type singularities where there is spontaneous change in local "spatial" signature. Because of this condition it is impossible to construct closed causal cycles which contradict causality in the sense of the concept on the invariant direction of the flow of time. The process proposed can be used to avoid certain types of singularities in general relativity and at the same time provide for a means of creation of enormous amounts of energy as observed in some of the recently discovered objects (quasars) or destruction on a grand scale as proposed in case of black holes. (auth)

5252 (MATSCIENCE-76, pp 180-204) SOLUTIONS FOR THE SPHERICALLY SYMMETRIC MASSIVE SCALAR (MESON) FIELDS. Nagaraja, M. (Bangalore Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

Some important formulas related to the spherically symmetric Einstein–Riemann manifold V_4 are collected. A brief description of Takeno classification of spherically symmetric space-time, based on the "Weierstrass characteristic" of the Ricci or the Einstein tensor, is given. In spherically symmetric space-times, the so-called "canonical" (or "curvature") coordinate system and the "standard" (or "co-moving") coordinate system play a very important role. Their importance stems from the fact that they enable one to simplify calculations. They are not always admissible for any given spherically symmetric V_4. Their admissibility depends on the classification of spherically symmetric space-times. There is also the question of simultaneous admissibility of the two types of coordinate systems. One obtains some important relations which lead to two theorems. One of these theorems gives a complete characterization for a time-like Born-rigid congruence. It is shown that it is impossible for a "standard" coordinate system to be at the same time a "canonical" one. This is done by constructing a counter-example with the help of the massive scalar field. This leads to two important results concerning Born-rigidity and the static nature of the space-time. The Einstein equations are reduced to a system of three ordinary nonlinear differential equations which is consistent. (auth)

5253 (MATSCIENCE-76, pp 285-289) CYLINDRICALLY SYMMETRIC ELECTROMAGNETIC FIELD OF THE SECOND CLASS. Tripathi, V. N.; Roy, S. R. (Banaras Hindu Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

Solutions representing the cylindrically symmetric electromagnetic field of the second class are presented. (JFP)

5254 CONVENTIONALITY IN DISTANT SIMULTANEITY. Feenberg, E. (Washington Univ., St. Louis). Found. Phys.; 4: No. 1, 121-126(Mar 1974).

Thought experiments are described in which the one-way velocity of light appears as a physical quantity. A rotating shaft is used to define distant synchrony for a system of clocks along the shaft. In this context Einstein's definition of distant simultaneity is seen as based on a physical assumption (and not merely on an overwhelmingly sensible choice in a range of conventional possibilities). (auth)

5255 QUANTUM-RELATED REFERENCE FRAMES AND THE LOCAL PHYSICAL SIGNIFICANCE OF POTENTIALS. Aharonov, Y. (Univ. of South Carolina, Columbia); Carmi, G. Found. Phys.; 4: No. 1, 75-81(Mar 1974).

In a sequel to previous work two thought experiments are discussed which show that potentials in force-free regions have not only a nonlocal physically measurable significance (via, e.g., $\oint A \cdot dl$), but, in singly connected portions of that region, also have a necessary local significance (via their quantum spread ΔA, which cannot be neglected) it is then shown in continuation to the foregoing work, how such A arise "geometrically" as kinematic quantities associated with the transformation between "quantum-related" reference frames, e.g., when the relative frame velocities are q-numbers possessing a quantum spread. (auth)

5256 TACHYONS via SUPERSONICS. Shankara, T. S. (Indian Inst. of Tech., Madras). Found. Phys.; 4: No. 1, 97-104 (Mar 1974).

An apparent inadequacy of the velocity addition theorem in handling a Fizeau (like) experiment beyond the resonance frequence is shown not to be a true failing. The proof consists in showing that the invariance of the signal velocity is unrelated to its maximality. Next, Lorentz transformations which connect frames moving with supersignal velocity to those of subsignal velocity are derived, taking a cue from the acoustic case. Methods are also suggested for laboratory verification of the theory. (auth)

5257 IS TIME DILATION PHYSICALLY OBSERVABLE. Kantor, W. Found. Phys.; 4: No. 1, 105-113(Mar 1974).

The circular arc swept out by the angular displacement of a clock indicator (or its equivalent representation) measuring time is shown to be a Lorentz invariant, representing "universal" time. The concepts of time dilation and transverse Doppler effect are accordingly not physically observable. The experiments on these effects when examined critically are found to be inconclusive. Length contraction, also experimentally unconfirmed, and kinematic temporal phase, both consequences of the Lorentz transformations, are as a matter of logical consistency also physically unobservable. (auth)

5258 SUPEROPERATOR-TRANSFORMATION THEORY FOR THE NEUTRAL SCALAR FIELD WITH A FIXED SOURCE. Williams, J. G. (Univ. Libre, Brussels). Physica; 71: No. 1, 91-98(1 Jan 1974).

The superoperator theory of nonequilibrium statistical mechanics is applied to the neutral scalar field with a fixed source. The matrices diagonalizing the hamiltonian are found and used to construct the dressing operator χ. Its inverse, χ^{-1}, is derived and verification is made of the prediction of the superoperator theory: that χ^{-1} acting on the free-field hamiltonian will give the renormalized energy spectrum. (auth)

5259 EXPANSION METHODS FOR THE SPINOR–SPINOR BETHE–SALPETER EQUATION. Ladányi, K. (Institut für Theoretische Physik der Universität Tübingen, Germany). Ann. Phys. (N.Y.) 77: No. 1, 471-516 (1 May 1973).

The structure of Wick–rotated spinor–spinor Bethe–Salpeter equations is studied in coordinate space. Investigations are extended for nonzero external mass differences, the interaction includes ladder–like contributions of scalar, pseudoscalar, vector and axialvector mesons. After eliminating the γ matrices, a set of coupled partial differential equations is obtained which is written in terms of scalar and three–vector amplitudes. By decomposition of the amplitudes in terms of four–dimensional scalar and three–vector spherical harmonics, two systems of coupled ordinary differential equations are derived for the radial wavefunctions. These equations involve a set of matrix elements which are summarized for arbitrary values of angular momenta in a transparent form. Some important symmetry properties of the radial Bethe–Salpeter equations are discussed. The method is feasible for computations including numerical calculations of Regge trajectories. As a by–product, useful relations for four–dimensional scalar and three–vector spherical harmonics are derived. (auth)

5260 NORMAL PRODUCTS AND THE SHORT DISTANCE EXPANSION IN THE PERTURBATION THEORY OF RENORMALIZABLE INTERACTIONS. Zimmermann, W. (Department of Physics, New York University, New York, N.Y. 10003). Ann. Phys. (N.Y.) 77: No. 1, 570-601 (1 May 1973).

Normal products are defined in perturbation theory for renormalizable interactions of a scalar field. Various identities involving normal products are derived. As an application Wilson's asymptotic short distance expansion is verified in perturbation theory for a product of two field operators. (auth)

5261 COMPOSITE OPERATORS IN THE PERTURBATION THEORY OF RENORMALIZABLE INTERACTIONS. Zimmermann, W. (Department of Physics, New York University, New York, 10003). Ann. Phys. (N.Y.) 77: No. 1, 536-569 (1 May 1973).

In perturbation theory the Green's functions of composite operators are constructed by applying Bogoliubov's method of renormalization. Normalization conditions for the composite operators are derived, as well as identities which relate composite operators of different degree. (auth)

5262 REMARKS ON THE SHORT DISTANCE BEHAVIOR OF SPINOR–SPINOR BETHE–SALPETER AMPLITUDES. Ladányi, K. (Institut für Theoretische Physik der Universität Tübingen, Tübingen, Germany). Ann. Phys. (N.Y.) 77: No. 1, 517-535 (1 May 1973).

The Wick–rotated spinor–spinor Bethe–Salpeter equation is applied to study the short distance behavior at vanishing c.m. energy and external mass. Effective interactions are fixed as particular superpositions of scalar, pseudoscalar vector and axialvector contributions. Short distance properties of the amplitudes suggest simple expansions for numerical solutions of the Bethe–Salpeter equation at nonzero c.m. energies and external masses. It is found that, for singular effective interactions, boundary conditions and other consistency requirements restrict the choice of coupling parameters characterizing the interaction at short distances. (auth)

5263 ULTRALOCAL SPINOR FIELD MODELS. Klauder, J.R. (Bell Telephone Laboratories, Inc., Murray Hill, New Jersey 09774). Ann. Phys. (N.Y.) 79: No. 1, 111-130 (July 1973).

Ultralocal spinor (fermion) field theories are distinguished by the independent temporal development of the field at each spacial point. For a wide class of models explicit operator constructions are given, in a positive definite Hilbert space, for the interacting field, the Hamiltonian, and several other operators. Not only do the fermion field operators fail to fulfill canonical anticommutation relations but associated ultralocal boson fields are required for their realization giving rise to both fermion and boson type excitations. Construction of the Hamiltonian from the field, as well as the transition from the interacting to the noninteracting theories entails various infinite renormalizations that are made explicit. The formulation and solution of these models is based solely on symmetry arguments and general principles, and makes no use whatsoever of cutoffs or perturbation theory. (auth)

5264 DYNAMICS OF A NONLINEAR FIELD. Mathews, P.M.; Lakshmanan, M. (Department of Theoretical Physics, University of Madras, Madras–25, India). Ann. Phys. (N.Y.) 79: No. 1, 171-185 (July 1973).

A systematic study is made of the plane wave modes of a nonlinear c–number field ($\lambda\phi^4$ model) and interesting features of the behavior of such fields, which do not seem to have been observed before, are brought out. These relate to the case $\lambda < 0$, wherein there are different regimes characterized by different kinds of elliptic–function forms for the waves. We show that when the amplitude of the elliptic function waves approaches critical values corresponding to "phase transition" from one regime to another, the energy density in the field increases without limit (though the amplitude is finite). In two of the regimes which are "tachyonic" in nature, there are frozen wave modes which are spatially periodic but time independent. These turn out however to be unstable against perturbations. Finally we observe that in one of these regimes there exist a lower bound on the energy density in the wave field. The case of fields with higher nonlinearities is briefly considered. (auth)

5265 DERIVATION OF AN EFFECTIVE LAGRANGIAN FROM A GENERALIZED SCALAR CURVATURE. Barnebey, T.A. (Department of Physics, University of California, Los Angeles, California 90024). Ann. Phys. (N.Y.) 82: No. 1, 264-297 (Jan 1974).

A spinor Lagrangian invariant under global coordinate, local Lorentz and local chiral SU(n) $\times$SU(n) gauge transformations is presented. The invariance requirement necessitates the introduction of boson fields, and a theory for these fields is then developed by relating them to generalizations of the vector connections in general relativity and utilizing an expanded scalar curvature as a boson Lagrangian. In implementing this plan, the local Lorentz group is found to greatly facilitate the correlation of the boson fields occuring in the spinor Lagrangian with the generalized vector connections. The independent boson fields of the theory are assumed to be the inhomogeneously transforming irreducible parts of the connections. It turns out that no homogeneously transforming parts are necessary to reproduce the chiral Lagrangian usually used as a basis for phenomenological field theories. The Lagrangian in question appears when the gravitational interaction is turned off. It includes pseudoscalar, spinor, vector, and axial vector fields, and the vector fields carry mass in spite of the fact that the theory is locally gauge invariant. (auth)

5266 QUANTUM ELECTRODYNAMICS WITH "TWO–PARTICLE" UNITARITY: CHARGED SPIN–0 BOSONS. Manoukian, E.B. (Theoretical Physics Institute, University of Alberta, Edmonton, Alberta, Canada). Ann. Phys. (N.Y.) 82: No. 1, 248-263 (Jan 1974).

The spin–0 propagator in quantum electrodynamics of charged spinless bosons ("pions") is investigated in detail via the closet approximation to the Schwinger–Dyson equation in the two–paticle unitarity approximation proposed initially by Salam by replacing the photon propagator by its zero order result. The high–energy behavior (in spacelike directions) of the (renormalized) spin–0 propagator $\Delta(p^2)$ is explicitly derived and a finite electromagnetic mass excitation for the "pion" is obtained. The latter follows as a result of the derived asymptotic behavior of $\Delta^{-1}(p^2)$ $(p^2 \to \alpha)$ that the unrenormalized mass $m_0 \equiv 0$. This brings us into contact with earlier work of Johnson, Landau and their collaborators. The fact that $m_0^2 \equiv 0$ and that $\Delta^{-1}(p^2)|_{p^2=-m^2} = O(m-0)$ (in Nambu's sense) gives us an eigenvalue equation for the fine structure constant which may be then computed in terms of no other parameters. This eigenvalue equation is expanded in powers of the coupling constant with all the expansion coefficients being finite. The latter is computed to sixth order in the charge. (auth)

5267 ANOMALOUS DIMENSIONS OF TENSOR OPERATORS IN 4–EPSILON DIMENSIONS. Hu, B. (Cornell Univ., Ithaca, NY). Phys. Lett.; 49B: No. 2, 168-170(1 Apr 1974).

Anomalous dimensions of tensor operators that determine the Callan–Gross and Corwall–Norton sum rules for the deep inelastic structure functions are calculated to first order in ϵ in the pseudoscalar Yukawa coupling model. Their values are found to be intermediate between those for the ϕ^4 model and the gluon model. (auth)

5268 COMMENTS ON THE PAPER "EQUIVALENCE THEOREMS FOR MASSIVE SPIN–ONE PARTICLES". Jenkins, J. D. (Durham Univ., Eng.). Lett. Nuovo Cim.; 9: No. 15, 581-582(13 Apr 1974).

Comments are made on the applicability of the generalized Matthews rule in Kyriakopoulos formalism of equivalence theorems. A brief discussion of the equivalence theorem is then given. (LBS)

5269 SPINOR INTERACTIONS IN THE TWO–DIMENSIONAL LIMIT. Delbourgo, R.; Prasad, V. B. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 21A: No. 1, 32-44(1 May 1974).

It is shown how the Thirring model with its anomalies can be treated by dimensional regularization. (auth)

5270 LARGE MOMENTUM BEHAVIOR AND ANALYTICITY IN THE COUPLING CONSTANT. Parisi, C. (CERN, Geneva). Nuovo Cim.; 21A: No. 1, 179-186(1 May 1974).

The general solution of the differential equation for a vertex mass insertion which is manifestly regular at zero external momenta is written. The large–momentum behavior of the solution and its analyticity properties in the coupling constant are discussed. Very different results are found for superrenormalizable, renormalizable and nonrenormalizable theories. (auth)

5271 MASTER EQUATION FOR PERTURBATIONS TO THE SCHWARZSCHILD GEOMETRY. Lun, A. W. C. (Monash Univ., Clayton, Australia); Fackerell, E. D. Lett. Nuovo Cim.; 9: No. 15, 599-602(13 Apr 1974).

A Schroedinger-type equation is presented for the gauge-dependent Newman-Penrose quantity ψ_{2B} (first order perturbation of the component ψ_2 of the Weyl tensor) by making a suitable choice of gauge. Because of the closely related nature of the Schroedinger-type equations which govern scalar perturbations and electromagnetic perturbations and the new equation for ψ_{2B}, the whole process of small perturbations to the Schwarzschild geometry can be summarized in a single master equation. (LBS)

5272 ANOMALIES IN THE TRACE IDENTITY OF THE STRESS TENSOR. A Normal-Product Approach. Schweda, M. (Technische Hochschule, Vienna). Lett. Nuovo Cim.; 9: No. 15, 596-598(13 Apr 1974).

The simplest nontrivial case in meson-nucleon dynamics is studied to derive tha anomaly of the trace identity for the energy-momentum tensor within the framework of normal products. (LBS)

5273 GAUGE DEPENDENCE OF RENORMALIZATION GROUP PARAMETERS. Caswell, W. E.; Wilczek, F. (Princeton Univ., NJ). Phys. Lett.; 49B: No. 3, 291-292(15 Apr 1974).

The restrictions that gauge invariance places on the renormalization group parameters in arbitrary gauge theories are derived. It is explicitly shown that the physical content of the renormalization group is gauge independent. A remarkable simplification is noted in the dimensional regularization scheme. (auth)

5274 QUANTIZATION OF GEL'FAND–YAGLOM EQUATIONS FOR FREE FIELDS OF ARBITRARY SPIN. Cox, W. (Univ. of Aston, Birmingham, Eng.). J. Phys., A (London); 7: No. 1, 1-11 (1 Jan 1974).

The Gel'fand–Yaglom equations for free fields of arbitrary spin are considered in the particular case when the field transforms according to a direct sum of inequivalent, irreducible finite representations of the proper Lorentz group. Under the assumption that the theory carries neither physical state of zero charge or energy density and that the mass–spin states are nondegenerate, the precise forms of the minimal and characteristic polynomials of the s blocks of the L_0 matrix are obtained which are then used to obtain new necessary and sufficient conditions that the theory be quantizable. The representation according to which the field transforms can be depicted graphically in a simple way and advantage of this is taken to use some simple ideas of graph theory to obtain the results. This graphical approach is useful in practical and theoretical considerations in the theory. One conclusion is that it will probably be necessary to allow repeated irreducible representations of the proper Lorentz group for theories of spin greater than eight to be quantizable. (auth)

5275 QUANTUM FIELD THEORY FOR NONPOLYNOMIAL CHIRAL LAGRANGIANS. Taylor, J. G. (King's Coll., London). J. Phys., A (London); 7: No. 1, 12-23(1 Jan 1974).

Green function equations and perturbation rules for chirally-invariant quantum field theory are deduced. The ordering problem is treated by a suitable time-like averaging in the operator interaction, which at the same time prevents any occurrence of $\delta^4(0)$ terms and removes ambiguities in $(\delta^3(0))^2$ terms; these latter are known to cancel to lowest order. Also an equivalent Lagrangian formulation is presented which leads to the same results. (auth)

5276 TIME CORRELATIONS FOR THE THIRRING MODEL WITH POSITIVE INTERACTION. Bogoliubov, N. N. Jr.; Shumovskii, A. G.; Shumovskii, A. S. (Moscow State Univ.). Phys. Lett.; 47A: No. 4, 269-270(8 Apr 1974).

It is shown that the time correlation functions and Green functions of a general Thirring model with positive interactions can be evaluated exactly in the thermodynamic limit. (auth)

5277 POSSIBILITY OF BREAKDOWN OF LORENTZ INVARIANCE IN THE TAKAHASHI–UMEZAWA QUANTIZATION METHOD. Jenkins, J. D. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 3, 346-351(11 Feb 1974).

The Stuckelberg formalism (Helv. Phys. Acta.; 11: 299-328 (1938)) for a massive spin-one field interacting with external potentials, is quantized following the method of Takahashi and Umezawa (Prog. Theor. Phys.; 9: 14-32(1953)). It is shown how the characteristic determinant of the field equations, which, in an earlier paper (Jenkins, J. Phys. A: Math. Nucl. Gen.; 6: 1935-1942(1973)), was shown to have the same form as the Lee–Yang determinant, for such a theory, determines the possibility of breakdown of Lorentz invariance in the procedure of the Takahashi–Umezawa quantization method. (auth)

5278 BOREL SUMMABILITY OF A PARTIAL PROPAGATOR IN A SELF-INTERACTING FIELD THEORY. Burt, P. B. (Clemson Univ., SC). J. Phys., A (London); 7: No. 3, 356-359(11 Feb 1974).

The asymptotic series for a partial propagator in a self-interacting field theory, constructed from exact, particular solutions of the field equations, is shown to be Borel summable except for singularities on the light cone. The source of the divergence of the series is the occurrence of a term of the form $\langle 0|A_k^{(\frac{1}{2})2n+1} A_q^{(-\frac{1}{2})2p+1}|0\rangle$, where A_k^+ are annihilation and creation operators of the linear theory. (auth)

5279 GEOMETRICAL LAGRANGIAN FOR THE NEUTRAL SCALAR MESON FIELD. Bicknell, G. V. (Univ. of Sydney). J. Phys., A (London); 7: No. 3, 341-345(11 Feb 1974).

A lagrangian derivation of the field equations expressing the gravitational effect of a nongravitational field usually necessitates the introduction of a field external to the geometry. It is shown, that in the case of a neutral scalar meson field, a geometrical lagrangian exists which yields the Einstein equations for such a field. The result is singular in that the method used here not be used to derive a geometrical Lagrangian for any other nongravitational field. (auth)

5280 ANALYTIC COMPUTATION OF SOME INTEGRALS IN FOURTH ORDER QUANTUM ELECTRODYNAMICS. Fox, J. A.; Hearn, A. C. (Univ. of Utah, Salt Lake City). J. Comput. Phys.; 14: No. 3, 301-317(Mar 1974).

A program for the analytic evaluation of some parametric integrals which occur in fourth order QED calculations is described. (auth)

5281 CONSTRUCTIVE QUANTUM FIELD THEORY. 1973 Ettore Majorana International School of Mathematical Physics, Erice, Italy, July 26–August 5, 1973. Velo, G.; Wightman, A. (eds.). Lecture Notes in Physics. Volume 25. New York; Springer-Verlag (1973). 336p. (CONF-730737-). $10.70.

The lectures cover functional analysis and probability theory, Euclidean Green functions and Wightman distributions, probability theory and Euclidean field theory, the Glimm–Jaffe ϕ-bound: a Markov proof, the particle structure of the weakly coupled $P(\phi)_2$ model and other applications of high temperature expansions, the bose field theory as classical statistical mechanics, constructive macroscopic quantum electrodynamics, perturbation expansion for the $P(\phi)_2$ Schwinger functions, non-discrete spins and the Lee–Yang theorem, Euclidean Fermi fields. (JFP)

5282 CAUSALITY AND RELATIVISTIC DYNAMICS. Havas, P. (Temple Univ., Philadelphia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 23-47(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

It is pointed out that one must distinguish between causality as a general property of some physical theories expressing that the time development of closed systems is determined if the initial state is suitably specified, and specific cause-effect relations arising from the action of an outside agent on an open system. The connection between the space-time structure of the special theory of relativity and its causality requirements is discussed briefly, and some common misunderstandings are clarified. The consequences of these requirements for classical relativistic theories of systems of interacting mass points are discussed; it is argued that they do not impose any restrictions on the description of closed systems, but only of open ones, since it is only the latter for which the concept of causal anomaly is physically meaningful. Thus no restrictions are imposed on the possible existence of particles moving faster than light (tachyons) within closed systems, but the possibility of purposeful production of and experimentation with tachyons must be excluded. Similarly, for closed systems, particles are not restricted to interactions describable by fields; indeed, at least to order c^{-2}, any field-theoretical interaction acting over intervals in or on the future light cone of the source (commonly mislabeled "causal") is equivalent to an interaction (similarly mislabeled "noncausal") acting over a space-like interval. (auth)

5283 RELATIVITY AND THE ORDER OF CAUSE AND EFFECT IN TIME. Newton, R. G. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 49-64(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

Signal velocities greater than that of light are well known to be ruled out by a combination of the theory of relativity and causality, because their existence would lead to the possibility of causal cycles. The reason for this prohibition is exhibited, and the relevant aspects of the notion of causality are analyzed. It is argued that the logical basis of the distinction between cause and effect is not their temporal order, but that it rests on the issue of control. The notion of control is then examined in this context. (auth)

5284 QUANTUM THEORY WITH SHADOW STATES: A SEPARATE REALITY. Sudarshan, E. C. G. (Univ. of Texas, Austin). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 115-136(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

Starting with an analysis of the natural (but not inevitable!) assumptions of conventional quantum theory the desirability of a generalization is highlighted. I give an exposition of a new scattering theory in which a new class of states enter; these states are relevant for the dynamical description but do not contribute to probability. The transition amplitude in this theory is calculated; it obeys the unitarity relation. Its relation to the standard scattering amplitude enables one to calculate it by simple methods and to study its piecewise analyticity. Certain causality questions are discussed, and certain paradoxes resolved. A number of deserving candidates for the role of shadow particles are listed. It is suggested that perhaps "general interpretational principles of quantum theory" are not as general as they should be or could be. (auth)

5285 TACHYONS, CAUSALITY, AND ROTATIONAL INVARIANCE. Everett, A. E. (Tufts Univ., Medford, MA); Antippa, A. F. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 147-155(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

A previously developed one-dimensional causal theory of tachyons is extended to three dimensions. The result is a three dimensional theory of interacting tachyons in which coordinates in reference frames with subluminal relative velocity are related by the Lorentz transformations, and in which no paradoxes involving causal loops can arise. The resulting theory involves a preferred spatial direction and preferred velocity perpendicular to that direction, so that physical laws governing tachyons are not invariant under rotations or proper Lorentz transformations. This lack of invariance should manifest itself even in processes involving only bradyons, to the extent that coupling to virtual tachyons is important. Discussed are the limits which experimental evidence on the validity of rotational invariance places on tachyon couplings in the theory and possible additional experiments for searching for lack of such invariance. (auth)

5286 EQUIVALENCE OF STANDARD AND COVARIANT PERTURBATION SERIES IN NONPOLYNOMIAL PION LAGRANGIAN FIELD THEORY. Honerkamp, J.; Krause, F.; Scheunert, M. (Univ., Hamburg). Nucl. Phys.; B69: No. 3, 618-636(1974).

Recently a covariant perturbation approach has been developed to give a perturbation expansion of the chiral-invariant pion theory which does not depend on the choice of pion coordinates. It is proved that this covariant approach is equivalent to standard perturbation theory. The method explicitly shows how one can express covariant graphs by contributions of non-covariant ones and vice versa. Contributions vanishing on the mass shell are neglected. (auth)

5287 PROPAGATION OF SOLUTIONS FOR THE WAVE EQUATIONS DESCRIBING THE PARTICLES WITH ARBITRARY SPIN. Nagpal, A. K. (Univ. of Delhi, India). Nucl. Phys.; B72: No. 2, 359-364(1974).

The causal propagation of Hurley wave equations for a massive particle with an arbitrary spin s, interacting minimally with an external electromagnetic field, is found to be due to the nature of the β-matrices satisfying Harish Chandra's condition analogous to the spin-one case. (auth)

Gravitation and General Relativity

Refer also to abstracts 4323, 4596, 5265, and 5279.

5288 (MATSCIENCE-76) PROCEEDINGS OF THE CONFERENCE ON COSMOLOGY, GRAVITATION, AND APPLICATIONS TO PARTICLE THEORY, BANGALORE, NOVEMBER 5-9, 1971. (Institute of Mathematical Sciences, Madras (India)). May 1973. 305p. (CONF-711156-). Inst. of Mathematical Sciences, Madras $1.00.

The conference included 23 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 4126, 4148, 4215, 4322, 4596, 4648, 5240, 5251-5253, and 5289-5301.

5289 (MATSCIENCE-76, pp 1-9) EINSTEIN: A NATURAL COMPLETION OF NEWTON. Ramakrishnan, A. (Inst. of Mathematical Sciences, Madras). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The relativistic theory is presented as a natural continuance and completion of Newtonian ideas using as an approach the velocity transformation formula. (JFP)

5290 (MATSCIENCE-76, pp 28-29) CHARGED DUST SPHERES IN GENERAL RELATIVITY. Bohra, M. L.; Mehra, A. L. (Jodhpur Polytechnic, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

A previous balanced field equation with canonical form of the static and spherically symmetric line element of -2 signature is used to obtain general solutions applicable to charged material bodies. The spherically symmetric solutions due to Schwarzschild or Penney are the particular case of the obtained solutions. (JFP)

5291 (MATSCIENCE-76, pp 48-63) CONTRACTION OF CHARGED FLUID SPHERES IN GENERAL RELATIVITY. Krishna Rao, J. (South Gujarat Univ., Surat, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The general relativity equations for the dynamics of charged fluid spheres (of null conductivity) are given. The geometrical part of the field equations is simplified by introducing the eigenvalue of the Weyl tensor in the 2-2 component of the Einstein tensor. This eigenvalue is interpreted as the energy density of the free gravitational field. It is shown that the fluid spheres thus obtained can be matched over a boundary with the Nordstrom solution. By assuming spatial isotrophy, it is shown that, the equations governing collapse, in particular, the energy equation can be considerably simplified. (auth)

5292 (MATSCIENCE-76, pp 103-135) CONSERVATION LAWS IN CLASSICAL AND QUANTUM MECHANICS AND IN GENERAL RELATIVITY. Mariwalla, K. H. (Inst. of Mathematical Sciences, Madras). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The relation between the formulation of conservation laws in general relativity and elsewhere in physics is explored. The nature of kinematical and dynamical conservation laws in mechanics and relativity and their associated coordinate transformation groups are reviewed. Then the automorphism groups of Riemannian space, the similarity of conservation laws in general relativity and quantum mechanics, a program for the study of conservation laws in general relativity, and the use of pseudo groups of coordinate transformations as dynamical groups of special relativity are discussed. (JFP)

5293 (MATSCIENCE-76, pp 137-148) STATIC CHARGED DUST DISTRIBUTIONS IN GENERAL RELATIVITY. Misra, R. M. (Univ. of Gorakhpur, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

A review of the Weyl class of electromagnetic fields is presented. The axially symmetric Weyl fields are recapitulated in a slightly different form. Then the results were extended to space-time admitting a hypersurfaces orthogonal timelike killing fields and filled with charged incoherent matter. The metric coefficients and the electromagnetic field tensor are assumed to be functions of x^1, x^2, and x^3. It is then shown that by making use of the functional relation between g_{44} and the electromagnetic potential one can fine a solution of the coupled Einstein-Maxwell equations in terms of a solution of the Einstein equations with incoherent matter as source. (auth)

5294 (MATSCIENCE-76, pp 149-160) STATIONARY AXIALLY SYMMETRIC FIELDS AND THE KERR METRIC. Misra, R. M.; Pandey, D. B. (Univ. of Gorakhpur, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The axially symmetric metric for a stationary gravitational field, in a slightly general form, is discussed. The vacuum field equations for this metric are given. Specialization of this metric leads to different form of field equations previously discussed in literature. In particular, the Kerr metric is given in a new form. A justification for interpreting the Kerr metric as an exterior solution corresponding to a spinning rod or a rotating spherical body is given. (auth)

5295 (MATSCIENCE-76, pp 161-169) STATIONARY CHARGED DUST DISTRIBUTIONS IN GENERAL RELATIVITY. Misra, R. M.; Pandey, D. B.; Srivastava, D. C. (Univ. of Gorakhpur, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The Einstein-Maxwell equations for a stationary gravitational field are investigated. The space is assumed to be filled with charged incoherent matter. It is then shown that if one assumes a vanishing Lorentz force everywhere, the charge density is always an arbitrary constant multiple of mass density. (auth)

5296 (MATSCIENCE-76, pp 170-179) SPECIAL CLASS OF GRAVITATIONAL FIELDS. Misra, R. M.; Tripathi, S. N. (Univ. of Gorakhpur, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The properties of a special class of gravitational field characterized by a metric admitting a timelike killing vector which is not hypersurface orthogonal are discussed. It was shown that the gravitational fields of this class may be considered, in some sense, equivalent to gravitational fields in 3-dimension plus a matter field. Also, a theorem was proved which enables one to obtain fields of this class from static fields. (auth)

5297 (MATSCIENCE-76, pp 205-220) EXTERNAL FIELD OF AN OSCILLATING ELECTRIC DIPOLE-LIKE SOURCE IN EINSTEIN'S UNIFIED FIELD THEORY. Pant, D. N. (Banaras Hindu Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

An attempt is made to obtain the external field of an oscillating electric dipole in Einstein's unified field theory. (JFP)

5298 (MATSCIENCE-76, pp 233-240) GRAVITATIONAL RADIATION IN FIELDS ASSOCIATED WITH PARTICLES OF ZERO REST MASS. Radhakrishna, L. (Shivaji Univ., Kolhapur, India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The trace of energy-momentum tensor of fields associated with particles of zero rest mass vanishes. By splitting the curvature tensor R_{hijk} into three 3-tensors of the second rank in a normal coordinate system, self-conjugate fields are defined in a manner analogous to that of the electromagnetic field. This formalism leads to three different types herein termed as A, B, and C. The necessary and sufficient condition that such a field associate with particles of zero rest mass be self-conjugate of type A were obtained by Roy and Radhakrishna (1962). Self-conjugate fields of type B are studied. The necessary conditions are expressed in an invariant form. The analysis of the 3-tensors for the electrovac universes is also given. (auth)

5299 (MATSCIENCE-76, pp 259-268) GEOMETRODYNAMIC ANALOG FOR CLASS ONE SPACE-TIMES. Roy, S. R.; Kapoor, K. (Banaras Hindu Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

Analogous to the problem of geometrodynamics for Einstein-Maxwell fields, the possibility of replacing certain given conditions by equivalent conditions which are couched entirely in terms of the metric quantities is investigated. It is found that this is possible except in the case of a space-time of class one which is called degenerate of the second kind. A new proof of the incompatibility of a nonflat empty space-time with class one condition is given. (JFP)

5300 (MATSCIENCE-76, pp 275-276) GRAVITATIONAL INVARIANT $S = R_{hijk} R^{hijk}$. Tikekar, R. S. (Univ. of Poona). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

The gravitational invariant of the curvature tensor is studied with reference to the metric $ds^2 = Ddt^2 - Adx^2 - Bdy^2 - Cdz^2$. (JFP)

5301 (MATSCIENCE-76, pp 277-284) APPROXIMATE SOLUTION IN A CYLINDRICALLY SYMMETRIC MAGNETOSTATIC FIELD IN EINSTEIN'S UNIFIED FIELD THEORY. Tiwari, R.; Kashyap, J. N. S. (Banaras Hindu Univ., India). May 1973.

From conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).

A cylindrical symmetric total field of which the electromagnetic part is characterized by g^{24} alone. From classical point of view g^{24} corresponds to a magnetic field. It is found after solving field equations (Einstein 1953) that the magnetic field varies inversely as the distance from z-axis and is in the ϕ-direction. Such a magnetic field is produced by a current along z-axis. A discussion of motion of a test particle is presented. (auth)

5302 COSMOLOGICAL IMPLICATIONS OF A NEW LAW OF GRAVITATION. Kobus, J. P. Found. Phys.; 4: No. 1, 53-64(Mar 1974).

Utilizing a geometric interpretation of gravitation within the framework of Einstein's general relativity, it is found that only expanding, spatially isotropic universes are allowed. The law of gravitation is taken in the form $R_{44} = 0$ where R_{44} is the component of the contracted Riemann-Christoffel (Ricci) tensor representing the curvature of time. All that is required in addition to $R_{44} = 0$ is that the Gaussian curvature R be nowhere infinite. (auth)

5303 VECTOR POTENTIAL AND RIEMANNIAN SPACE. Lanczos, C. (Dublin Inst. for Advanced Studies). Found. Phys.; 4: No. 1, 137-147(Mar 1974).

The basic reason for the mysterious change of sign from plus to minus in the fourth coordinate of nature's Pythagorean law, usually accepted on empirical grounds, although it destroys the rational basis of a Riemannian geometry is uncovered. A genuine, positive-definite Riemannian space and an action principle which is quadratic in the curvature quantities (and thus scale invariant) are assumed. The constant σ between the two basic invariants is equated to $\frac{1}{4}$. Then the matter tensor has the trace zero. In consequence of the constancy of the scalar curvature and the divergence identity of the matter tensor, the perturbation metric has to satisfy a scalar and a vector condition, with a negative sign in the fourth coordinate. These conditions lead to the Lorentz condition and the wave equation for the vector potential. Thus the entire Maxwell-Lorentz type of electrodynamics becomes logically derivable, making no concession to any irrationality. (auth)

5304 GRAVITATIONALLY INDUCED ELECTROMAGNETIC RADIATION. Johnston, M. (Joseph Henry Laboratories, Princeton, New Jersey 08540); Ruffini, R.; Zerilli, F. Phys. Rev. Lett. 31: No. 21, 1317-1319 (19 Nov 1973).

A fully relativistic treatment is given to analyze the electromagnetic radiation induced by gravitational perturbations in extreme relativistic regions. For the sake of clarity, results are presented here for the simplest possible example: an uncharged mass m falling radially into a field of a Reissner-Nordström solution. Explicit results governing the energetics of the process are found. The amount of electromagnetic radiation radiated can be of the order of magnitude of the gravitational one. (auth)

5305 SEPARABILITY OF THE NEUTRINO EQUATIONS IN A KERR BACKGROUND. Unruh, W. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 31: No. 20, 1265-1267 (12 Nov 1973).

The first-order neutrino equations are shown to be separable in the Kerr-metric background. These equations are then used to show that the neutrino field is not superradiant, in contrast to the scalar, electromagnetic, and gravitational fields. (auth)

5306 SHEAR-FREE, TWISTING EINSTEIN-MAXWELL METRICS IN THE NEWMAN-PENROSE FORMALISM. Lind, R. W. (Syracuse Univ., NY). Gen. Relativity Gravitation; 5: No. 1, 25-47(Feb 1974).

The problem of finding algebraically special solutions of the vacuum Einstein-Maxwell equations is investigated using the spin coefficient formalism of Newman and Penrose (J. Math. Phys.; 3: 566 (1962)). The general case, in which the degenerate null vectors are not hypersurface orthogonal, is reduced to a problem of solving five coupled differential equations that are no longer dependent on the affine parameter along the degenerate null directions. It is shown that the most general regular, shear-free, nonradiating solution of these equations is the Kerr-Newman metric (J. Math. Phys.; 6: 918 (1965)). (auth)

5307 RELATIVISTIC DEFORMABLE SOLIDS AND THE DETECTION OF GRAVITATIONAL WAVES. Maugin, G. A. (Univ., Paris). Gen. Relativity Gravitation; 5: No. 1, 13-23 (Feb 1974).

A preceding work (Maugin, J. Gen. Rel. Grav.; 4: 241-272(1972)) is complemented, and it is shown, in agreement with the theory of relativistic deformable solids developed by A. C. Eringen (Mechanics of Continua, Wiley, New York (1967)) and his coworkers, that the simplest conceivable dissipative constitutive equation—that of a so-called Kelvin-Voigt viscoelastic solid—yields a gravitational wave equation of propagation different from that of Weber: specifically, the following third order partial differential equation, $\partial^2\theta/\partial t^2 - [A + A' \partial/\partial t]\, \partial^2\theta/\partial x^2 = c^2 R_{1441}$ which can be solved by use of Fourier transform techniques, and where A and A′ are positive material coefficients. (auth)

5308 ELLIPSOIDAL SOLUTIONS OF LIOUVILLE'S EQUATION IN GENERAL RELATIVITY. Truemper, M. (Texas A and M Univ., College Station). Gen. Relativity Gravitation; 5: No. 1, 1-12(Feb 1974).

A relativistic, collisionless gas of gravitating particles all having the same proper mass (possibly equal to zero) is studied under the assumption that the one-particle distribution function is locally ellipsoidal in momentum space with respect to some time-like vector field (observer). Liouville's equation implies that the distribution function depends only on a quadratic form in the 4-moments, whose coefficients are a Killing tensor in the case of nonvanishing proper mass, and a conformal Killing tensor in the case of vanishing rest mass of the particles. It is suggested that cosmological models of Bianchi-type I can be described in terms of ellipsoidal momentum distribution functions whose el-

lipsoidal tensor is built out of the Killing vectors associated with the spatial homogeneity. (auth)

5309 MOTION OF CHARGED RADIATING SHELLS IN GENERAL RELATIVITY AND FRIEDMON STATES. Frolov, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 3, 813-825(Mar 1974). (In Russian).

The equations of motion of charged radiating shells in general relativity are derived. It is shown on basis of this model that transitions of open systems to semi-closed ones and also transitions from non-Friedmon to Friedmon states should be possible at the anti-collapse stage as a result of energy and charge emission processes. (auth)

5310 SCALING MOTION IN GENERAL RELATIVITY FOR A SPHERICALLY SYMMETRIC SYSTEM IN SPECIAL COORDINATES. Stanyukovich, K. P. (All-Union Scientific-Research Inst. for Physical-Technical and Radiotechnical Measurements, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 3, 826-832(Mar 1974). (In Russian).

The equations of general relativity theory are considered in the case of central symmetry with the purpose of determining scaling solutions. A special set of independent variables m, r are chosen instead of the variables t, r. This simplifies the equations and facilitates their solution. Some exact particular solutions of the "scaling" equations are found. (auth)

5311 PARTICLE DRIFT IN THE FIELD OF A GRAVITATIONAL WAVE. Grishchuk, L. P. (State Astronomical Inst., Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 3, 833-837(Mar 1974). (In Russian).

Photons, as well as nonzero mass particles, on propagating in the field of a gravitational wave experience a periodic "bending of their rays". This deviation is small but may build up as a result of repeated photon reflection between two ideally reflecting mirrors. In order of magnitude the drift length or distance Δl between the point of photon emission and the point of return to the same mirror can be determined by the formula $\Delta l/\lambda = hQ$ where h and λ are the amplitude and length of the gravitational wave and Q is the number of reflections between the mirrors separated by a distance $\lambda/2$. The direction of the drift depends on the phase of the gravitational wave at the time of photon emission and on its polarization. The effect may be employed for detecting gravitational waves. (auth)

5312 PROPERTIES OF KEPLER'S CIRCULAR ORBITS AS SOLUTIONS OF EQUATIONS FOR THE EXTERNAL PROBLEM OF TWO GRAVITATING BODIES TAKING INTO ACCOUNT THE DEFLECTION OF THE ARGUMENT IN GENERAL RELATIVITY THEORY. Pisarenko, V. G. (Inst. of Mathematics, Kiev). Dopov. Akad. Nauk Ukr. SSR, Ser. A; No. 2, 178-184 (Feb 1974). (In Ukrainian).

The properties of special solutions of equations obtained previously for two N gravitating bodies external problem are studied with taking into account the argument deflect in the general relativity theory. The expression for solutions closest to Kepler's circular orbits is obtained for the two bodies problem. It is shown that stability of these solutions with accuracy up to the exponentially decreasing factor coincides with one of the corresponding solutions of Newton's mechanics. (auth)

5313 GLOBAL SOLUTIONS OF THE CONSTRAINTS EQUATIONS ON OPEN AND CLOSED MANIFOLDS. Choquet-Bruhat, Y. (Univ., Paris). Gen. Relativity Gravitation; 5: No. 1, 49-60(Feb 1974).

The constraints equations of general relativity are reduced on an initial maximal submanifold, by the use of conformal techniques, to a non-linear elliptic equation for the conformal factor ϕ. Some existence, uniqueness, and nonexistence theorems are proved for this equation, in the case of closed manifolds, and also for open manifolds (in particular for manifolds homeomorphic to IR^3). (auth)

5314 GLOBAL ANALYSIS AND GENERAL RELATIVITY. Fischer, A. E.; Marsden, J. E. (Univ. of California, Santa Cruz). Gen. Relativity Gravitation; 5: No. 1, 73-77(Feb 1974).

An outline of recent applications of modern infinite-dimensional manifold techniques to general relativity is presented. The uses, scope, and future of such methods are delineated. It is argued that the mixing of the two active fields of general relativity and global analysis provides stimulation for both fields as well as producing good theorems. Previous work on linearization stability of the Einstein equations is sketched out to substantiate the arguments. (auth)

5315 EQUATIONS OF MOTION OF MACROSCOPIC BODIES IN GENERAL RELATIVITY. Hogan, P. A.; McCrea, J. D. (Dublin Inst. for Advanced Studies). Gen. Relativity Gravitation; 5: No. 1, 79-113(Feb 1974).

A new approach to the problem of motion in general relativity, based upon the systematic approximation procedure of Synge (Proc. Roy. Ir. Acad.; A67: 47 (1969) and A69: 11 (1970)) is presented. The equations of translational motion for a system of spherical bodies moving under their mutual gravitational attractions are derived. Approximations are based upon the weakness of the field and on the distance between any two of the bodies being considered large by comparison with their radii. The most general stress distribution consistent with maintaining the symmetry of the bodies throughout the motion is chosen. The use of controlled errors enables one to derive equations of motion applicable to a wider class of physical systems than the original equations of Einstein, Infeld and Hoffmann (Ann. Math.; 39: 65 (1938)) and Fock-Papapetrou (Proc. Phys. Soc.; A64: 57 (1951)). (auth)

5316 CONFORMALLY NON-STATIC PERFECT-FLUID DISTRIBUTION. Singh, K. P.; Abdussattar. (Banaras Hindu Univ., India). Gen. Relativity Gravitation; 5: No. 1, 115-118 (Feb 1974).

A nonstatic generalization of the Schwarzschild interior solution was obtained which is conformal to flat space-time. (auth)

5317 CONSTANT TENSOR FIELDS IN THE GENERAL THEORY OF RELATIVITY. II. Polozov, M. N.; Kremen'kov, O. V. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 73-80(1974). (In Russian).

The conditions of stationarity of tensor fields assigned to ortho reference points were examined in the sense of independence from natural time. The necessary conditions of stationarity for any tensor field were found. A series of theorems was shown on the sufficient sign of the stationarity in some particular cases. The equivalence of the tetrad and chronometric invariant approach in the determination of constant fields was shown. (tr-auth)

5318 STATIC TWO BODY PROBLEM. Zum Hagen, H. M. (King's Coll., London). Proc. Cambridge Phil. Soc.; 75: 249-260(Mar 1974).

The problem of whether there exist solutions of Einstein's equations for two extended bodies surrounded by vacuum is investigated. Equilibrium conditions for the general static situation are derived and their physical meaning discussed. Special cases of the problems are solved by using these equilibrium conditions. In one of these cases, the essential assumptions are that the space–time is axisymmetric and that the matter of which the two bodies are composed consists of perfect fluid. Solutions are also obtained in which these restrictions are weakened. (auth)

5319 NULL MAXWELL FIELDS. Hall, G. S. (King's Coll., London). Lett. Nuovo Cim.; 9: No. 16, 667-669(20 Apr 1974).

An elementary electromagnetic interpretation is given of Kundt's solution with plane waves for a null Maxwell field in general relativity theory. (LBS)

5320 GRAVITATIONAL CHARGE, HADRON HYDRODYNAMICS AND GOEDELISED HADRONS. Fennelly, A. J. (Yeshiva Univ., New York). Nature (London); 248: No. 5445, 221-223(15 Mar 1974).

A discussion is presented on current approaches to particle physics, and comparisons made point to a consistency that is not immediately apparent. The parton model, $\int$-gravity, and the hydrodynamical model of multiple particle production in high energy hadron collisions are found to be complementary in remarkable ways, and indicate a useful general formalism for particle physics problems in such diverse applications as collisional mass spectra to the first picoseconds of the universe according to the "big-bang" theory. It is considered useful to examine a fluid description of the hadrons in which the cosmological constant may also have a meaning, and in this connection consideration is given to Goedel's universe (Rev. Nucl. Phys. 21: 477 (1949)). It is concluded that there is a remarkable consistency in gravitationally/hydrodynamically oriented approaches to the structure of fundamental particles, and a much greater range of applicability than has been recognized. (UK)

5321 WAVE SOLUTIONS IN GENERAL RELATIVITY. Patel, L. K. (Gujarat Univ., Ahmedabad, India). Proc. Cambridge Phil. Soc.; 75: 261-267(Mar 1974).

A general scheme for the derivation of wave solutions in general relativity is developed. Some solutions describing the flow of gravitational waves are discussed. Singular electromagnetic fields corresponding to one particular solution are also discussed. (auth)

5322 RELATIVITY, ASTROPHYSICS, AND COSMOLOGY. Proceedings of the Summer School, Banff, Alberta, August 14–26, 1972. Israel, W. Astrophysics and Space Science Library, Vol-

ume 38. Dordrecht, Netherlands; D. Reidel Publishing Company (1973). 340p. $32.60.

Topics discussed include the structure of Einstein's theory of gravitation, various types of experiments designed to test the validity of the general theory of relativity, the possible end states of stellar evolution in spherical and nonspherical geometry, the Einstein/De Sitter model of cosmological evolution, the quantization of gravity in terms of canonical variables, and the construction of an updated differential geometry for handling problems in relativity theory and cosmology. (IAA)

5323 ON THE STABILITY OF HOMOGENEOUS, SPHERICALLY SYMMETRIC, CHARGED FLUIDS IN RELATIVITY. Stettner, R. (Department of Physics, Montana State University, Bozeman, Montana 59715). Ann. Phys. (N.Y.) 80: No. 1, 212-227 (Sept 1973).

A normal mode, stability analysis is applied to a spherically symmetric fluid system which contains a constant surface charge. The stability of the system is analyzed for the situation in which the electromagnetic mass is only a small fraction of the total mass and also for the situation in which the electromagnetic mass is the total gravitational mass. This latter situation corresponds to that of a Poincaré-Lorentz fluid electron. (auth)

5324 COVARIANT DESCRIPTION OF MOTION IN GENERAL RELATIVITY. Lathrop, J.D. (Harvard College Observatory, Cambridge, Massachusetts 02138). Ann. Phys. (N.Y.) 79: No. 2, 580-595 (Aug 1973).

Proceeding by analogy with a covariant treatment of inertial accelerations in Newtonian kinematics, we obtain a covariant decomposition of the general relativistic inertial acceleration into its impressed, D'Alembert, Coriolis, centrifugal, Euler, and tidal gravitational components. We also develop a covariant formulation of geodesic precession, Thomas precession, the dragging of inertial frames, and the energy shift (gravitational and Doppler) of light. (auth)

5325 THE MECHANICS OF PARTICLES INSIDE A ROTATING CYLINDRICAL MASS SHELL. Pietronero, L. (Department of Physics, Istituto di Fisica dell'Università, Roma, Italy). Ann. Phys. (N.Y.) 79: No. 1, 250-260 (July 1973).

It is shown that up to the second order in the gravitational constant the effect of a rotating mass shell on a particle moving near its axis is the same as that of a rotating coordinate system. Coriolis force and centrifugal force have, contrary to the case discussed by Thirring [1,2], the value expected in a rotating reference frame. (auth)

5326 COVARIANT GAUGES AND POINT SOURCES IN GENERAL RELATIVITY. Duff, M.J. (Physics Department, Imperial College, London SW7 England). Ann. Phys. (N.Y.) 79: No. 1, 261-275 (July 1973).

The tree graph contributions to the vacuum expectation value of the quantized gravitational field produced by a point mass source are found to diverge. These divergences can be removed only by giving the source a finite extension, and it is first necessary to analyze the corresponding classical situation before making a comparison with the quantum theory. In this paper, the model for such an extended particle is taken to be a spherical shell of initially static pressure-free dust. Without solving the Einstein equations explicitly, a coordinate-independent mass renormalization formula can be derived, valid at the moment of time symmetry, which relates the total mass of the system to the bare mass of the source and its invariant radius. The equations are then solved for various choices of coordinate systems, allowing the invariant radius of the shell to be expressed in terms of its coordinate dependent extension. The results are in agreement with those obtained previously by Arnowitt, Deser, and Misner. The work of these authors is generalized to include coordinate frames for which the metric is discontinuous across the shell. Aside from any intrinsic interest, such a generalization is necessary since the most convenient coordinate system for the quantum calculations, namely the covariant de Donder (harmonic) gauge, falls into this category. By expanding the total mass of the source in terms of its bare mass and harmonic coordinate extension, the classical Schwarzschild solution may be cast into a form which facilitates a direct comparison with the quantum theory in the de Donder gauge. (auth)

5327 A CLASS OF EXACT SOLUTIONS FOR COUPLED ELECTROMAGNETIC AND SCALAR FIELDS FOR EINSTEIN-ROSEN METRIC. II. Roy, A.R.; Rao, J.R.; Tiwari, R.N. (Department of Mathematics, Indian Institute of Technology, Kharagpur-2 (W.B.) India). Ann. Phys. (N.Y.) 79: No. 1, 276-283 (July 1973).

This paper is a continuation of the author's earlier work entitled "A class of exact solutions for coupled electromagnetic and scalar fields for Einstein-Rosen metric. I." [Ann. Physics 69 (1972), 473]. In this paper we have interpreted some of the solutions from different viewpoints with special reference to singular behavior. It has been observed that the presence of zero mass scalar meson fields does not affect the singular behavior as when the electromagnetic field only is present. (auth)

5328 A CLASS OF EXACT SOLUTIONS FOR COUPLED ELECTROMAGNETIC AND SCALAR FIELDS FOR EINSTEIN-ROSEN METRIC. PART IA. Rao, J.R.; Tiwari, R.N.; Roy, A.R. (Department of Mathematics, Indian Institute of Technology, Kharagpur—2(S.E.Rly.), W. Bengal, India). Ann. Phys. (N.Y.) 78: No. 2, 553-560 (June 1973).

In the previous work [1] we have obtained a class of exact solutions for the nonstatic cylindrically symmetric Einstein-Rosen metric in the presence of combined electromagnetic and zero-rest-mass scalar meson fields. But, these solutions are restricted because of assuming certain conditions on the scalar field. The present work deals with all the solutions obtained in the previous paper without any such restriction. The class of exact solutions obtained thus is more general than that given in [1]. (auth)

5329 ANGULAR ANISOTROPY OF SYNCHRONOUS RADIATION IN THE GRAVITATIONAL WAVE FIELD. Pargamanik, L. E.; Dimanshtein, F. A. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 1, 158-160(Jan 1974). (In Russian).

The interaction of synchronous radiation with plane linearized gravitational waves was examined. It was shown that such an interaction does not change the general energy emitted by the discharge but leads to the appearance of supplementary anisotropy. The difference of the radiation flux through the semisphere at two moments of time is proportional to the change of the gravitational potential. The phenomenon examined can be used for the detection of gravitational waves. (tr-auth)

5330 ELECTROMAGNETICALLY INDUCED GRAVITATIONAL RADIATION. Johnston, M. (Princeton Univ., NJ); Ruffini, R.; Zerilli, F. Phys. Lett.; 49B: No. 2, 185-188(1 Apr 1974).

Using a general relativistic treatment the coupled emission of gravitational and electromagnetic radiation is analyzed in the simplest possible radiation process: a massive charged particle falling radially into a Reissner-Nordstrom geometry. Particular attention is given to a detailed analysis of the "feedback" terms between gravitational and electromagnetic radiation. (auth)

5331 FALLING BODY IN THE THEORIES OF GRAVITATION. Rao, K. N. S.; Rao, A. V. G. (Mysore Univ., India). J. Phys., A (London); 7: No. 4, 485-488(1 Mar 1974).

The motion of a test particle falling in the spherically symmetric field of another heavy body was studied in a few of the theories of gravitation proposed recently. It is shown that while the predicted behavior of the test particle in the new theories of gravitation agrees with that of the general theory of relativity (GTR) for small velocities and weak fields, the new theories predict certain results which are qualitatively different from those of GTR when the fields are strong and the velocities are high. For example, the falling body is shown to encounter variable singular regions and repulsive fields in the new theories of gravitation whereas in GTR the field is attractive everywhere outside the Schwarzschild sphere, for arbitrarily high velocities of the falling body. (auth)

5332 GENERALIZATION OF EINSTEIN'S PRINCIPLE OF EQUIVALENCE SO AS TO EMBRACE THE FIELD EQUATIONS OF GRAVITATION. Klein, O. Phys. Scr.; 9: No. 2, 69-72(Feb 1974).

It is shown that the apparent impossibility of deriving Einstein's field equations of gravitation in a way similar to that used by him in deriving the equations of particle motion and electromagnetism—being a direct generalization of his famous imaginary experiment of a box falling freely in a gravitational field—may be overcome by using the quantal vacuum with its fluctuations instead of the vacuum of ordinary physics with its absolute emptiness. Thus, the Dirac equation with gravitation, thereby used, appears, in contrast to the ordinary view, as the prototype of interaction theory based on general principles, one of them being a generalized principle of equivalence. (auth)

5333 EXISTENCE AND MEASUREMENT OF ENERGY IN THE GRAVITATIONAL FIELD. Unt, V. A. (Inst. of Physics, Tartu, USSR). pp 141-149 of Methodological Analysis of the Theoretical and Experimental Bases of Gravitational Physics. Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

Analysis of the Einstein equations by the successive approximation method and their second-order integration indicate that an energy source can release gravitational waves which carry away some of its energy and that, as a consequence, a gravitational field is a phenomenon having a physical reality. Expressions describing the energy of gravitational fields are discussed. Approaches to an analysis of the concept of gravitational force are considered. (IAA)

5334 ONTOLOGICAL STRUCTURE OF PHYSICAL LAWS AND THE PROBLEM OF CORRESPONDENCE OF SPACE, TIME, AND

MATTER IN THE GENERAL RELATIVITY THEORY. Uemov, A. I. (Odessa State Univ.). pp 179-184 of Methodological Analysis of the Theoretical and Experimental Bases of Gravitational Physics. Kiev; Izdatel'stvo Naukova Dumka (1973). (In Russian).

5335 CAUSALITY AND METRICAL PROPERTIES OF MATTER IN A TWO-METRIC FIELD THEORY OF GRAVITY. Nordtvedt, K. Jr. (Montana State Univ., Bozeman). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 16, 137-146(1974).

From symposium on causality and its role in physical theories; Detroit, Michigan, USA (11 May 1973). See CONF-730576-.

If cosmological structure is the result of two metrical tensor fields, causal structure is surprisingly modified with signals traveling faster than light and effects preceding causes when viewed by certain inertial observers. Metrical structure is seen to be a property of matter rather than an attribute of the "space-time" four-dimensional event continuum. (auth)

REACTOR TECHNOLOGY AND REGULATION

5336 (WASH-1304) SURVEY OF UNIQUE TECHNICAL FEATURES OF THE FLOATING NUCLEAR POWER PLANT CONCEPT. (USAEC Directorate of Licensing, Washington, D. C.). Mar 1974. 112p. Dep. NTIS $5.45.

The manufacture, installation, operation, and decommissioning of floating nuclear power plants at offshore sites are examined with respect to the major technical differences between such plants and land-based nuclear power plants. Anticipated environmental effects of activities associated with offshore nuclear plants are discussed. Possible accidents both inplant and during the transport of radioactive materials to and from an offshore plant are described and an initial estimate of their relative significance presented. (auth)

5337 PRODUCTION OF NUCLEAR ENERGY IN FRANCE. Hannothiaux, A. (Electricite de France, Paris). Bull. Soc. Roy. Belge Elec.; 89: No. 4, 297-307(1973). (In French).

5338 PRODUCTION OF ELECTRICITY OF NUCLEAR ORIGIN. Pericart, J. Sci. Tech. (Paris); No. 10, 35-44(15 Jan 1974). (In French).

Work presented at the 9th Congress of the Electrical, Electronic and Radioengineers Society at Vittel on the production of electricity of nuclear origin is reviewed. The following subjects were covered: different types of electronuclear reactor; nuclear fuels; environmental safety; electronics associated with nuclear plants; turboalternators, gas turbines and auxiliary equipment; the introduction of electricity of nuclear origin into the grid. (FR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 2566, 5431, 5528, 5633, 5635, 5639, and 5649.

5339 (CONF-730942-P4, pp vp Paper J 1/3) CALCULATION OF THE TRANSIENT LONG TERM PRESSURE AND TEMPERATURE BEHAVIOR IN A CONTAINMENT AFTER A LOSS-OF-COOLANT ACCIDENT. Brosche, D.; Mansfeld, G. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The transient long term pressure and temperature behavior in the containment of a nuclear power plant starts after the termination of the blowdown from the primary system and pressure equalization between the different compartments in the containment. Contrary to the short term pressure behavior which occurs within seconds, the long term behavior takes place within minutes to hours. An extensive parametric study has been performed with a computer code to investigate the influence of the following parameters on the pressure and temperature transients: heat transfer coefficients to the inner surface of the outer wall, heat transfer in the gap between steel and concrete layer of the outer wall, quantity of temperature nodes in solid structures, thermodynamic nonequilibrium between gaseous and liquid phase, behavior of the secondary system (pressurized water reactor), small breaks, and spray cooling system (new mathematical model). This parametric study rendered new and very important results about the different significance of the above mentioned parameters on the numerical values of pressure and temperature maxima and temperature distributions in solid structures. With these informations it is possible to calculate very exactly the thermodynamic long term behavior and to specify safety margins to allow for uncertainties in some assumptions so that the stresses in the structure can be determined. 8 references. (auth)

5340 (CONF-730942-P4, pp vp Paper J 1/4) VENT CLEARING TRANSIENTS, LOCAL MAXIMA OF PRESSURES AND PRESSURE DIFFERENCES IN A PRESSURE SUPPRESSION SYSTEM DURING THE SHORT TERM BEHAVIOR. Parametric Studies and Experimental Results. Brosche, D.; Mansfeld, G. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For the calculation of the stresses of a pressure suppression system of a nuclear power plant during a loss-of-coolant accident (LOCA) and therefore for its layout it is necessary to know very exactly the different thermo- and fluid-dynamic processes causing these stresses. In a pressure suppression system the end of the vent pipe system which connects the drywell with the wetwell submerges into the condensation pool of the wetwell. During the first phase of the accident the water column in the vent pipe is forced out by the overpressure in the drywell causing considerable pressure pulses on the bottom and the side walls of the wetwell. To calculate their range an extensive study has been performed with an appropriate computer code showing the influences of the following parameters: size and composition (steam-air-ratio) of the mass flow rate, initial submergence depth, unequal load of parallel vent pipes and giving new informations about the magnitudes of these important pressure pulses for the cases of a loss-of-coolant accident and a pressure relief transient of the pressure vessel. In addition to this, analytical results have been tested with new experiments. The drywell of a pressure suppression system ordinarily is subdivided into a quantity of compartments which are connected in different manners by flow paths, so that local maxima of pressure and pressure differences occur which generally exceed strongly the equilibrium pressure in the drywell calculated by many analyses performed until now and which are determining the layout. Therefore the influence of many parameters like composition of the two-component two-phase flow (steam-air-water mixture) between the compartments, blowdown flow rate, number of the pressure nodes, etc. on the local pressure distribution has been investigated by a parametric study with a computer code giving new quantitative results about the space and time dependent pressure distribution. Distinct calculated pressure transients also have been tested with new experimental results. 7 references. (auth)

5341 (CONF-730942-P4, pp vp Paper J 1/7) CONSEQUENCES DRAWN FROM A STUCK RELIEF VALVE INCIDENT AT THE WUERGASSEN POWER PLANT. Voigt, O.; Koch, E. H.; Zeitzschel, G. (Kraftwerk Union AG, Frankfurt am Main). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The pressure suppression containment system of the BWR Würgassen Power Plant contains a water pool of about 2,000 tons of water. This water is provided to condense steam released from the high pressure reactor system in case of a leak in the pressure barrier (loss of coolant accident) or in case of certain operational conditions by means of relief valves. Eight relief valves with a capacity of 400 tons/hr steam each are vented into the pool by means of vertical pipes of 400 mm diameter and a submergence into the water of 2 m. During start-up tests in April 1972, one of the relief valves failed to close after being electrically initiated for a short opening period. Since the reactor was not shut down due to a deliberate operator decision, the reactor system was held at full operating pressure (70 at) for more than half an hour; consequently 200 tons of steam were delivered into the water pool, heating it up locally to boiling condition. While the pool temperature was rising, pressure pulses generated from the condensation process near the vent pipe exit increased considerably to such an extent that finally the bottom of the suppression chamber became locally damaged. Through leaks in the bottom water flew down into the containment sump. When the reactor finally was shut down, the system pressure dropped immediately, the stuck valve closed again and the situation was entirely under control, no radioactivity was released from the containment. Protective measures to prevent a reoccurrence are described. (auth)

5342 (CONF-730942-P4, pp vp Paper J 2/2) SOME NEW EXPERIENCES IN COMPUTATION AND CONSTRUCTION OF CONTAINMENTS IN POINT OF VIEW OF THE MANUFACTURER. Cech, F.; Fischer, D.; Zwingenberger, L. (Vereinigte Oesterreichische Eisen- und Stahlwerke AG, Linz, Austria). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Steel containments for boiling water reactors with an integrated condenser system present some special problems in computation and erection. During erection the sphere is positioned on four supports of an erecting-sled for transportation. Therefore, the dead weight of about 1000 tons is introduced in four nearly singular points on the shell. Stress analysis, support construction, and shell stability are analyzed. 3 references. (auth)

5343 (CONF-730942-P4, pp vp Paper J 2/7) DESIGN AND STRUCTURAL ANALYSIS OF PRESTRESSED CONCRETE CONTAINMENT FOR AEG PRODUCT LINE 72 BWR's. Mattern, J. (AEG-Telefunken, Frankfurt am Main); Fruehauf, H.; Meerwald, K. 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The new AEG Product Line Boiling Water Reactor is to be provided with a prestressed concrete containment vessel replacing the spherical steel containment that has been used for reactors to date. The concrete containment vessel encloses a pressure reduction system and is made up of a cylindrical concrete structure with an inner steel liner. It comprises two rooms—a dry-well and a wet-well (condensation pool)—that are separated from one another by a permanent concentric cylindrical wall and an annular slab. Surrounding the steel reactor vessel is an extra concrete cylinder that also acts as a shield. The structural design is described with special consideration to particular development phases. Demonstrated are the adverse effects of the individual components such as piping, liner and the concrete structure itself with special attention to the technical safety aspects. Special consideration was given to the design of the structure to enable analytical methods to be used to simplify the structural analysis. (auth)

5344 (CONF-730942-P4, pp vp Paper K 5/3) COMPARATIVE FORCED VIBRATION TEST OF TWO BWR-TYPE REACTOR BUILDINGS. Muto, K. (Muto Inst. of Structural Mechanics, Inc., Tokyo); Hayashi, T.; Omatsuzawa, K.; Ohta, T.; Uchida, K.; Kasai, Y. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The comparative forced vibration test of two GE-460 MW(e) BWR type reactor buildings by means of a vibrator is described. The tested nuclear power plants are the Fukushima nuclear power plant No. 1 of the Tokyo Electric Power Co. (hereinafter referred to as "Fukushima") and the Shimane nuclear power plant of the Chugoku Electric Power Co. ("Shimane"). They are almost the same in both structure and function, but are built on rock of quite different rigidity. The shear wave velocity of the Fukushima site is about ⅓ of that of the Shimane site. Test results are presented. 3 references. (auth)

5345 (DEU-73-26) GUNDREMMINGEN REACTOR. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (F. R. Germany)). [nd]. 12p. (In German). INIS.

The nuclear power plant is equipped for a gross capacity of 250 MW(e). Due to its significance in the development of nuclear energy, the German Federal Government and the European Atomic Energy Community (EURATOM) have supported the project. The brochure describes the working method of the whole reactor plant and presents the most important power plant data in tabular form. (GE)

5346 (IAEA-126, pp 213-241) SWEDISH DEVELOPMENT ON PRESTRESSED CONCRETE PRESSURE VESSELS FOR WATER REACTORS. Menon, S. (Aktiebolaget Atomenergi, Stockholm). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

A project to design, build, and test a model of a PCPV suitable for water reactors is in progress. The project is backed by the atomic energy organizations of Denmark, Finland, Norway and Sweden, as well as by utilities and the reactor industry in Sweden. The model, which has dimensions 2 m internal diameter and 4 m internal height, is characterized by its removable top head and its insulation system. The model has been hydraulically pressure tested at temperatures of 25°C and 70°C at pressures up to 95 bar. The tests included a 4-week test at 70°C and 85 bar (design pressure). The results have been very satisfactory. Insulation tests are due to start in March 1970. (auth)

5347 TEMPERATURE DYNAMIC ANALYSIS OF FUEL ELEMENTS FOR BOILING WATER REACTORS. Zaalouk, M. G. (Carolina Power and Light Co., Raleigh, NC); Mitry, A. M.; Peterson, W. C. Nucl. Sci. Eng.; 54: No. 1, 1-9(May 1974).

Normally a boiling water reactor operates in the nucleate region at a quiescent point on the boiling curve. Considering small variations which occur about the quiescent operating point, the fuel element temperature dynamics can be properly described by a transfer function relating incremental variation in the fuel element surface temperature and heat rate generated within. Transfer functions are derived to represent the heat transfer dynamics for plate and cylindrical fuel elements under boiling conditions. The heat rate generation is taken to be nonuniform and the special case of uniform heat is deduced. Computational results are presented for typical BWR fuel elements under different operating conditions. (auth)

5348 ACCURACY CONTROL OF THE BWR-TRANSIENT-MODEL BY RECALCULATION OF KWW-START-UP EXPERIMENTS. Braeuhaeuser, H.; Nogly, R. (Kraftwerk Union AG, Frankfurt am Main). (1974). vp. (In German).

From experts meeting of the task groups Thermodynamics and Fluid Dynamics and Reactor Physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, Germany (29 Jan 1974).

For the calculation of the dynamical behavior of boiling water reactors a transient model, DRAMP, was developed. The attainable prediction accuracy was tested by recalculation of three transients which were measured during the start-up of the Wuergassen reactor. (GE)

5349 SURVEILLANCE INSPECTION VIEWING AIDS: REVIEW OF OPERATING EXPERIENCE WITH UNDER WATER CCTV AT TARAPUR. Joshi, A. N. (Tarapur Atomic Power Station, India). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Various advantages of application of Closed Circuit Television systems for surveillance inspection of reactor components are enumerated. Various operational problems faced with underwater Closed Circuit Television systems while in use are also dealt with. In addition, suggestions to overcome various problems are also included. (auth)

5350 SUMMARY OF RECENT ABNORMAL OCCURRENCES AT POWER-REACTOR FACILITIES. Thompson, D. (Atomic Energy Commission, Washington, DC). Nucl. Safety; 15: No. 2, 198-210(1974).

Brief descriptions are presented of abnormal occurrences in U. S. power reactors during the period from October 1 to December 15, 1973. (DCC)

5351 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN NOVEMBER AND DECEMBER 1973. Casto, W. R. (comp.). (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 2, 210-212(1974).

Three boiling-water reactors (BWRs)—Pilgrim, Vermont Yankee, and the Swiss KKM reactor in Mühlenberg—experienced vibration and wearing of fuel elements caused by water flow. The problem is being corrected in these three reactors, which are the only reactors with the internal geometry to produce this unique water flow. Vermont Yankee, however, subsequently had additional problems due to an inadvertent criticality following core loading. Indian Point 2 experienced at 180° circumferential failure in an 18-in.-diameter steam-generator feedwater line. A nonreactor accident, reported here because of the unwarranted concern it raised, is the failure of an experimental gas-centrifuge model. 7 references. (auth)

5352 NEW ACCEPTANCE CRITERIA FOR EMERGENCY CORE-COOLING SYSTEMS OF LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. Nucl. Safety; 15: No. 2, 173-184 (1974).

In a 140-page report issued Dec. 28, 1973, the Atomic Energy Commission established revised ECCS design criteria, gave the schedule for their implementation, and presented a detailed technical justification for the revisions. Because of the interest in this matter, the new criteria and the introduction to the aforementioned report which summarizes the Commission's position are presented. The sections are presented as they appear in the Commission document except that referenced material has been expanded and placed at the end of the article and footnotes have been incorporated into the text. (auth)

5353 EVOLUTION AND CURRENT STATUS OF THE BWR CONTAINMENT SYSTEM. Wade, G. E. (General Electric Co., Hanford, WA). Nucl. Safety; 15: No. 2, 163-173(1974).

The containment system for boiling-water reactors has evolved from the dry spherical type used on Dresden 1 through four generations of pressure-suppression types. The Mark I, II, and III pressure-suppression containment sizes and arrangements are presented, and the reasons for the design evolution are discussed. The five basic modules in the pressure-suppression analytical model and a typical response to a loss-of-coolant accident are described. The test program being conducted to verify the new pressure-suppression horizontal vent design is briefly described. Overall design characteristics of the emergency core-cooling-system network, which is essential in maintaining the integrity of the containment, are outlined. The new Mark III containment design eliminates the need for inerting. The design objectives are outlined for the system that handles the hydrogen generated by the initial metal–water reaction of the zirconium. 26 references. (auth)

5354 HOW SAFE IS SAFE ENOUGH. van Dam, H. Ingenieur (Utrecht); 85: No. 28-29, 597-599(12 Jul 1973). (In Dutch).

A general discussion of nuclear safety standards is presented, with related topics in reliability and safety engineering. A proba-

bility analysis for a loss-of-coolant accident to a boiling-water reactor, showing the various containment procedures successively (and automatically) invoked, is included as an illustration. (NL)

5355 SUMMARY OF OPERATING U. S. POWER REACTORS. Nucl. Safety; 15: No. 2, 213-214(1974).

5356 YADERNAYA FIZIKA I YADERNYE REAKTORY. (Nuclear Physics and Nuclear Reactors). Klimov, A. N. Moscow; Atomizdat (1971). 384p.

The principles of nuclear physics necessary for the understanding of processes occurring in nuclear reactors are given in the first part of the book. These include atomic structure, physical properties of nuclei, spontaneous and induced nuclear transformations, interaction of moving particles with matter, and moderation and scattering of neutrons. The discussion of the physical facts is managed without inclusions based on a mathematical analysis. The second part of the book is devoted to nuclear reactors, but the discussion is on the physical phenomena and not on the calculation of reactors. A description is given of the basic types of reactors for power plants. (95 figures, 27 tables, 29 references) (tr-auth)

5357 WHAT CAN HAPPEN IN A NUCLEAR POWER STATION. Bergstroem, P. Tek. Tidskr.; 103: No. 19, 26-30(23 Nov 1973). (In Swedish).

A computer with a Sigma 8 central unit has been developed by ASEA LME Automation, which simulates the operation of boiling water and pressure water reactors in Swedish power stations and is to be used for training personnel. The computer can simulate 100 faults, and various starting conditions. (SW)

5358 POWER REACTORS 1974. Nucl. Eng. Int.; 10: No. 215, 303-343(Apr 1974).

Data on the power reactors of the world are summarized in tabular form. There are three sections which include details of owners, operators, contractors, economic data etc; technical information for the reactors arranged according to type; and progress schedules. Available information on stations planned to be built is also tabulated. (UK)

5359 FUEL ASSEMBLY FOR A NUCLEAR REACTOR AND LIFT GRAB FOR SUCH AN ASSEMBLY. Jones, C. R. (to Transfer Systems, Inc., North Haven, CT). German (FRG) Patent 2,243,774. 12 Apr 1973. 47p. (In German).

The described fuel assembly consists of an elongated case, split into several levels by supporting plates to take up several vertically mounted fuel elements. The assembly contains precautionary measures for the gearing of the lift grabs. The technical details of the assembly and grab are part of the patent. The aims of the discovery are the care of the fuel elements before loading, easy to dismantle, improved water guide and easy removal from the fission zone and re-insertion. (GE)

5360 TWO NODES MODEL FOR THERMAL ANALYSIS OF CIRCULAR NUCLEAR FUEL ELEMENTS. Zaki, G. M.; van der Meer, F. F. (Atomic Energy Establishment, Cairo). Atomkernenergie; 23: No. 1, 50-53(1974).

A method is described for the analysis of reactor power and fuel mean temperature variations at transient conditions. This method is based on two nodes model in which the fuel region is divided radially into two zones. Range of the ratio between the inner node radius and the fuel element radius (xi) is proposed (0.1−1). Iteration technique is then applied to get the optimal ratio to satisfy the desired constraints. The optimum ratio: xi = 0.765. Comparison of the temperature and power transients with 10 nodes model as a reference data results in a maximum deviation of 1%. This presented two nodes model can then be used in computer codes studying thermal performance of pressurized and boiling water reactors as long as this deviation is within the accuracy in the Doppler reactivity coefficient. (GE)

5361 SAFETY IN NORMAL NUCLEAR POWER GENERATION. Ishiwatari, N. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 19: No. 9, 19-25(Sep 1973). (In Japanese).

Safety measures taken in light-water nuclear power plants with BWRs and PWRs are described on the following: formation of radioactive nuclides; discharge and movement of radioactive substances from reactors to environment; and disposal of radioactive wastes. (JA)

5362 SAFETY IN REACTOR ACCIDENTS. ECCS for Light-Water Reactors. Togo, Y. (Tokyo Univ.). Genshiryoku Kogyo; 19: No. 9, 14-18(Sep 1973). (In Japanese).

With recent full-fledged nuclear power generation, the capacity of nuclear power plants is becoming large. An emergency core cooling system is used to minimize hazard in reactor accidents. The following are described: ECCS in loss of coolant accident; the historical development of ECCS; ECCS in BWRs and PWRs; experiments carried out for ECCS; recent development in ECCS; and ECCS standard in the U. S. AEC. The ECCS in recent years is multiple, including core spray, high and low pressure water injection, and high pressure spray. Among the experiments on the ECCS are those on blowdown, core spray, core flooding, etc. In the United States, the LOFT project for loss of coolant accident is going on at NRTS. Its semiscale blow-down experiment aroused the recent ECCS controversy, which led the U. S. AEC to formulate its ECCS standard. (JA)

5363 STAFFING AND TRAINING FOR NUCLEAR POWER PROJECTS. Dayal, M. (Tarapur Atomic Power Station, India). pp 423-435 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Information is presented concerning the staffing and training for nuclear power projects in India. (INIS)

5364 OPERATING EXPERIENCE WITH NUCLEAR POWER STATIONS IN MEMBER STATES. Chase, D.; Ilias, J.; Khan, M. (International Atomic Energy Agency, Vienna). pp 591-613 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

A brief summary is given of operating experience with major reactor systems until the end of 1970. The survey highlights the experience gained with major components and systems in successively the light water cooled reactors, the graphite moderated gas cooled reactors and the heavy water moderated reactors. A list is given of the nuclear power station units in operation as of 31 December 1970; a number of graphs are presented to provide an overall picture of the performance of the various reactor types. (auth)

5365 FRENCH NUCLEAR ELECTRIC PROGRAM, DEVELOPMENT OF BREEDER REACTORS. Carle, R. (CEA, Paris). At. Jap.; 17: No. 5, Suppl., 55-65(May 1973).

The French program of nuclear power development is reviewed, and particular emphasis is placed on FBR development. The French program consists of three main paths: improvement of LWRs, development of HTGRs and development of FBRs. The improvement of LWRs in reliability, safety and economy will be conducted on the basis of the experience acquired during submarine propulsion program. The development of HTGRs was decided to be performed, based on the license agreement and in co-operation with Gulf Company. A commercial tender for a 1200 MW(e) plant will be ready in 1974. For the FRB development, France has expended roughly $600 million since 1955. Research and development are being performed in various fields; neutron physics using Harmonie and Masurca; technological evaluation in the test halls of Cadarache center and steam generator testing stations (5MW and 50MW); study of safety with Cabri reactor, in particular on sodium-water reaction; fuel irradiation in experimental reactors. (JA)

5366 SUMMARY OF RECENT ABNORMAL OCCURRENCES AT POWER-REACTOR FACILITIES. Thompson, D. Nucl. Safety; 15: No. 3, 320-334(1974).

Abnormal occurrence reports for U. S. power reactors processed during December 15, 1973 to February 15, 1974 are listed. (DCC)

5367 WATER-REACTOR SAFETY-RESEARCH INFORMATION MEETING. Cottrell, W. B. Nucl. Safety; 15: No. 3, 241-262(1974).

The meeting included 37 presentations grouped into the following sessions: (I) Separate-Effects Program, (II) Loss-of-Fluid Test (LOFT) Program, (III) Power Burst Facility (PBF) Program, (IV) Loss-of-Coolant (LOCA) Analysis Programs, (V) Reactor Safety Studies, (VI) Regulatory Technical Assistance Programs, (VII) Heavy-Section Steel Technology Program, (VIIIa) Reactor Primary-Coolant-System Pipe-Rupture Studies, and (VIIIb) Vendor Reactor Safety Programs. Brief summaries of all presentations are included. 32 references. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 4818, 5339, 5346, 5350–5352, 5355, 5357, 5358, 5360–5362, 5364–5367, 5431, 5508, 5528, 5533, 5622, 5642, and 5649.

5368 (BAW-10003(Rev.3)) QUALIFICATION TESTING OF PROTECTION SYSTEM INSTRUMENTATION. Revision 3. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Apr 1974. 30p.

Protection system instrumentation is used in Babcock & Wilcox nuclear steam systems to initiate protective functions. The in-

strumentation includes the nuclear instrumentation and reactor protection system (NI/RPS) and the safety features actuation system (SFAS). Safety-oriented instrumentation must be very reliable, and qualification testing is required to verify that the design of the protective system equipment meets this requirement. The qualification testing was conducted in six phases: (1) System electronic module performance tests; (2) Remote sensor performance tests; (3) Long-term operational tests of the nuclear flux channels of the NI/RPS at an operational reactor; (4) Environmental tests of all system modules and components; (5) Seismic tests on all system modules and components; and (6) Failure analysis of the coincidence logic modules. The results are summarized as follows: (1) All of the system's electronic modules meet or exceed all of their design requirements for electronic performance for both normal (reference) operating conditions and for the entire design range of power supply, environmental, and seismic conditions. (2) All other system components, including all remote sensors, meet or exceed all of their design performance requirements for normal operating conditions and for the entire design range of environmental and seismic conditions. (3) The nuclear instrumentation system performed as required for one year at an operating reactor. (4) Any single failure of the coincidence logic modules will not prevent a required protective action, nor will it result in a false protective action. The failure would be detectable by normal operational testing. (auth)

5369 (CONF-730942-P4, pp vp Paper J 1/2) CONSIDERATION OF A LOSS-OF-COOLANT ACCIDENT LOAD IN THE DESIGN OF SUB-CONTAINMENTS OF CONTAINMENT INTERNAL STRUCTURES. Chao, R. N. P. (Bechtel Power Corp., Los Angeles). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A sub-containment is referred to as a compartment which houses a vital part of the primary coolant system of a typical PWR nuclear power plant such as: a reactor cavity, a steam generator cavity or sometimes a separate pressurizer chamber. Individual components of a Loss of Coolant Accident (LOCA) load and their combined effect in the design consideration of sub-containments are discussed qualitatively in general herein; however, numerical values are given in the example to show the order of magnitude and for the convenience of discussion. The jet impingement force, pipe restraint reaction, equipment support reaction, pressure differential across the wall of the sub-containment and thermal load on the compartment wall are briefly discussed and examined on diagrams with respect to the time following a LOCA. Then, with special emphasis, the problem of how to combine each component of LOCA load is outlined. A maximum possible earthquake is also assumed to occur simultaneously with the LOCA. The modeling of sub-containment structures is briefly described, the method of analysis, the result and its impact on the combined stress with the LOCA load are also discussed. Finally, various approaches to analyze the structure of sub-containment are compared and discussed with emphasis on the structural behavior with respect to each component of the LOCA load as well as seismic load. 8 references. (auth)

5370 (CONF-730942-P4, pp vp Paper K 4/6) SEISMIC ANALYSIS OF REACTOR CONTAINMENT FACILITY FOR PWR PLANT (COUPLED VIBRATION WITH ATTACHED BUILDINGS). Takemori, T.; Hama, I. (Taisei Corp., Osaka). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In seismic design of the reactor containment facility (hereinafter RCF) for a PWR nuclear power station, many structural problems occur; one of the problems is how to idealize the structure of this facility to a computable model, and another is whether to obtain the suitable computer program for seismic analysis. A layout of a PWR nuclear power station is assumed referring to actual PWR power stations and the dynamic analyses are carried out making several dynamic models from it. Earthquake waves employed in this study are El Centro NS 40, Taft 52EW and Golden Gate S80E. The maximum accelerations of these waves are normalized to 250 gal. Based on these results the variation of dynamic responses due to the difference of models are investigated to evaluate the dynamic analysis procedures. 3 references. (auth)

5371 (CONF-730942-P4, pp vp Paper K 6/4) SEISMIC RESISTANT ANALYSIS OF HEAVY EQUIPMENT OF PWR PLANTS. Chen, C. (Gilbert Associates, Inc., Reading, PA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The structures of a PWR are represented by composite cantilever beams overlaid one another. The soil is represented by swaying and rocking springs. The lumped mass method is used and each mass point is assigned with two horizontal degrees of freedom. The heavy equipment is also represented by lumped mass models. Instead of combining the structure model with equipment models, the stiffness matrices are combined. The stiffness of the equipment supports can also be represented by the support stiffness matrices. The different damping values of structure, equipment and soil are combined by the weighted damping method. Variation of soil, concrete properties and support conditions are covered by the parametric study. An example with four primary coolant loops and ice condenser is presented. 12 references. (auth)

5372 (CONF-730942-P4, pp vp Paper K 6/10) METHOD OF COLLIDING VIBRATION ANALYSIS OF PWR FUEL ASSEMBLIES UNDER SEISMIC CONDITION. Nuno, H.; Mizuta, M.; Kitade, K.; Saruyama, I. (Mitsubishi Atomic Power Industries, Inc., Tokyo). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Since fuel assemblies are installed in reactor core closely together, with small gaps, when seismic excitation is present, the vibration of the assemblies will cause lateral impacts between adjacent assemblies. In order to evaluate the soundness of fuel assemblies in seismic condition, a method of analyzing this non-linear colliding vibration problem was developed. One row of fuel assemblies in a PWR reactor core was taken into consideration, and its lateral vibration caused by seismic excitation in direction to the row was analyzed. A computer code FUVIAN (Fuel Vibration Analysis) to calculate the above problem was also developed, in which mode-superposing time-history method was used. This code calculates the displacement traces of each grid (impact point) of fuel assemblies, impact forces between two adjacent grids, etc. In order to confirm the validity of the method of FUVIAN, colliding vibration tests were conducted using a scaled beam-group model with sinusoidal excitation, and good agreements were found between test results and computer predictions. Further, a full scale fuel assembly vibration test and grid impact test were performed to obtain vibrational and impact parameter values for code input. The result of a sample calculation performed on one of the current typical fuel assemblies is presented, by which the general aspect of in-reactor colliding vibration behavior of fuel assemblies can be observed. (auth)

5373 (DEU-73-24) NUCLEAR POWER PLANT, BIBLIS. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). [nd]. 20p. (In German). INIS.

The construction and licensing procedures for the Biblis-A and Biblis-B reactors are reviewed. (DCC)

5374 (DLCS-5000473) SHIPPINGPORT ATOMIC POWER STATION. Quarterly Operating Report, Fourth Quarter 1973. (Duquesne Light Co., Shippingport, Pa. (USA)). 1973. Contract AT(11-1)-292. 24p. Dep. NTIS $4.25.

An operations summary for the Shippingport Atomic Power Station during the last quarter of 1973 is presented. Reactor and turbine plant water chemistry, radioactivity discharges, radioactive waste shipments, reactor maintenance, and test activities are also reported. (JWR)

5375 (EGU-5120208) DYNAMICS OF STEAM GENERATORS OF A VVER-TYPE NUCLEAR POWER PLANT. Safranek, A.; Rubek, J.; Bednarik, K.; Hanus, F. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)). 1973. 47p. (In Czech). INIS.

Preparation of input data and program arrangement are described for the computation of dynamic and static characteristics of steam generators of VVER-type nuclear power plants. The model is analyzed with regard to a shifting boiling point. (INIS)

5376 (IEN-TP-14-72) PARAMETRIC STUDIES ON PWR CORE USING LEOPARD CODE. Zoratto, D. L.; Khan, A. M. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Jul 1972. 37p. (In Portuguese). INIS.

Parametric studies have been performed on a PWR core of the same design and composition as the Brazilian Angra dos Reis Power Reactor Core, using the LEOPARD computer program. In this study the enrichments and the pin diameter remained constant at 2.2% and 0.422 in. respectively while the core temperature and void conditions as well as the hydrogen to metal ratio (H/M) or pitch were varied to observe the effect on minimum critical mass, material bucklings, and leakages. In all 56 LEOPARD runs were analyzed. (auth)

5377 (NEDO-10802) ANALYTICAL METHODS OF PLANT TRANSIENT EVALUATIONS FOR THE GENERAL ELECTRIC BOILING WATER REACTOR. Linford, R. B. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Feb 1973. 108p. (73-NED-29).

The BWR has evolved into a single thermodynamic cycle power system. The General Electric Transient Analysis Methods for the

single cycle BWR are examined. Included are three major sections: 1) a derivation and documentation of the necessary equations for the reactor and the most common auxiliary control and operating system options, 2) a sensitivity study to identify the effect of system parameters on system transient performance and 3) a comparison of pre-startup system analysis using the most conservative system design specifications and the startup transient results obtained from operating plants. The major features of the transient methods are point reactor kinetics; lumped pressure nodes of the core, vessel and steamline; multiple recirculation loop options with reversed or startup flow capability utilizing both jet-pump and full flow recirculation systems; internal steam separators; a wide range of turbine control, pressure relief, rod motion, and protection system options; and recirculation flow control. (auth)

5378 (RISO-298) SURVEY OF CALCULATIONS ON THE HADDAM NECK (CONNECTICUT YANKEE) POWER PLANT AS A TEST OF THE RISOE REACTOR PHYSICS CODE SYSTEM. Neltrup, H.; Suhr, P. B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1973. 62p. Dep. NTIS (U. S. Sales Only) $6.25.

A summary is presented of the stationary and quasistationary calculations carried out on the first core loading of the Connecticut Yankee Atomic Power Co. Haddam Neck Power Plant as a test of the Reactor Physics Department computer code system. The calculations described include calculations of criticality, reactivity coefficients, poison coefficients, differential and integral values of the control rod system, and power distributions during burn-up. (auth)

5379 CHOICE OF OPTIMAL PARAMETERS OF A NUCLEAR POWER STATION FOR HEAT SUPPLY. Arsen'ev, Yu. D.; Bereza, Yu. S.; Voronkov, M. E.; Mukhanov, S. I. At. Energ. (USSR); 36: No. 3, 174-177(Mar 1974). (In Russian).

Nuclear power stations for heat supply using water-moderated water-cooled power reactors are discussed. For coolant parameters of such stations, the ranges of peak thermal capacity for model core VVER-440, and also for fuel rods of smaller diameter and annular fuel elements, are analyzed. A method of determining optimal reactor capacity and pressure is given. (4 figures, 11 references). (auth)

5380 DAMPING OF XENON OSCILLATIONS IN THE MAINE YANKEE REACTOR. Corcoran, W. R. (Combustion Engineering, Inc., Windsor, CT); Humphries, J. R.; Litke, H. J.; LeBlanc, J. D. Nucl. Technol.; 22: No. 2, 252-262(May 1974).

Radial, azimuthal, and axial xenon oscillation experiments were performed at Maine Yankee to confirm experimentally the theoretical predictions of stability with respect to these three primary modes of xenon oscillation. These experiments and the evaluation of the data to obtain damping factors are discussed briefly, and the results are compared with predictive calculations. Calculated damping factors, based on linear modal analysis techniques using a best estimate of the total power coefficient, are found to lie within the uncertainty bounds of the experimentally determined damping factors. The results of the axial experiments are also used in conjunction with results from calculational models to estimate the time in life at which the onset of divergent axial xenon oscillations may be expected. 10 references. (auth)

5381 ATLANTIC GENERATING STATION. Ashworth, J. A. (Public Service Electric and Gas Co., Jacksonville, FL). Nucl. Technol.; 22 No. 2, 170-183(May 1974).

Studies have indicated that ~1000 MW(e) of base-load generation must be installed each year, beginning in the early 1980's, if the demand for power in New Jersey is to be met. Offshore siting of base-load generating stations can provide an answer to utilities beset by problems of population, cooling water, and licensing. This approach to siting presents unique opportunities to minimize construction costs by plant standardization and "serial" manufacturing. It also poses new design problems of plant motion, operation in a marine environment, plant size envelope, and coordination of plant and site design and licensing. 3 references. (auth)

5382 PROBLEMS OF EVALUATION OF A SINGLE BID FOR A NUCLEAR POWER PLANT. Matin, A.; Rahman, M. A.; Yusuf, M. (Pakistan Atomic Energy Commission, Karachi). pp 573-590 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Problems of evaluation of a single bid for the Karachi nuclear power plant and Rooppur nuclear power project are analyzed. (INIS)

5383 OPERATION AND MAINTENANCE EXPERIENCES OF MIHAMA NUCLEAR POWER STATION. Goto, N. pp 437-466 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The experiences in operating and maintaining the No. 1 Unit of the Mihama Nuclear Power Station are reviewed. (INIS)

5384 STRESS RELIEF OF LARGE VESSELS FOR A GERMAN NUCLEAR POWER PLANT. A Communication. Prod. Eng.; 53: No. 3-4, 109-111(Mar 1974).

Pre-heating and stress relieving was carried out for four steam generators to be installed in a new nuclear power station at Biblis "A", West Germany. The total weight of the steam generator was 900 metric tons and the welding process for the attachment of the primary chamber of the steam generator to the main body specified both pre-heating and stress relieving of this weld. The outside diameter of the vessel, at the weld seam, was just under three metres and the wall thickness was 150 mm. The project called for pre-heat temperatures up to 220°C and post-heat temperatures up to 610°C with a maximum temperature rise of 10°C/hr. (auth)

5385 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN JANUARY AND FEBRUARY 1974. Casto, W. R. Nucl. Safety; 15: No. 3, 335-338(1974).

Operators at Zion 1 were presented with an interesting cooldown problem when the main-steam-line isolation valves closed spuriously. At Oconee it was discovered that the heat-removal rate during natural convection of the primary water is probably too great. Also, the Oconee staff has used its loose-objects-detector system to help identify noises in one of its reactors. At R. E. Ginna the reactivity accidentally decreased during shutdown. Although the decrease was obviously no problem, the fact that it occurred accidentally was of concern. At the National Bureau of Standards research reactor, a supervisor was probably overexposed when procedures were violated during a fuel-transfer operation. (auth)

5386 ANALYSIS OF A SUDDEN MAJOR LOSS OF COOLANT ACCOMPANIED BY SERIOUS FAILURE OF EMERGENCY CORE COOLING. Case, E. G. Nucl. Safety; 15: No. 3, 285-291(1974).

In an article derived from testimony at a recent public hearing on an operating license for Prairie Island 1 and 2, AEC testimony as to the probability of a specific Class 9 accident—a sudden loss-of-coolant accident (LOCA) accompanied by a serious failure of emergency core cooling—was presented. In arriving at the conclusion that the probability for such an event would be less than 10^{-7} per reactor year and that the environmental risk of such an accident was negligible, failure probabilities were assigned to three steps in the accident sequence. The likelihood of a sudden major LOCA was in the range 10^{-3} to 10^{-5} per reactor year, the likelihood of serious emergency core-cooling-system failure was in the range 10^{-2} to 10^{-4} per reactor year, and the likelihood of containment breach was in the range 10^{-3} to 10^{-4}. The Commission's rationale for its probability estimates is analyzed. 33 references. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 5355, 5356, 5358, 5364, 5365, 5431, 5445, 5525–5527, 5641, and 5649.

5387 (AEEW-R-831) SOME PROBLEMS IN THE PHYSICS OF HIGH-TEMPERATURE REACTORS. Tyror, J. G.; Askew, J. R.; Johnstone, I. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Oct 1972. 16p. INIS.

From meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, New York, USA (12 Sep 1972).

To meet the accuracies required for design calculations on HTR systems, rather detailed theoretical models have been developed and validated by comparison with the results of an extensive program of specially designed experiments. The general philosophy is illustrated for 2 problem areas: resonance capture in granular fuel and within-block power distribution. While some problems still remain in the areas so far studied, the confirmation of the reactivity time predictions at high irradiation is identified as the most significant outstanding question. (auth)

5388 (CONF-730942-P4, pp vp Paper J 3/8) CONSTRUCTION AND CALCULATION OF THE SAFETY INSTALLATION "BURST DIMINISHER". Barnert, H. (Kernforschungsanlage, Juelich, Ger.). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The non-integrated primary circuit of nuclear reactors in several containers has for high-temperature reactors in addition to other advantages those of easy accessibility, repairability, and exchangeability of heat-consuming equipment (e.g. steam gen-

erator), and important cost-savings for the reactor pressure vessel. It is, however, necessary to connect these containers by pipe-conduits of a relatively large diameter. As far as the safety criteria for nuclear power plants are concerned, the rupture of such a pipe-conduit has to be considered already in design, in particular with respect to the system of after-heat removal. This means the burst-diminisher is an equipment to diminish the intensity and effects of bursts from pressure-retaining tube-walls, similar to the flow limiters of boiling-water reactors. Details regarding the construction of a burst-diminisher are given by the example of the coaxial conduits of a process-heat reactor. The burst-diminisher in a coaxial conduit consists of a pressure-retaining tube-wall with beaded edges. Models and calculations are introduced to design the "burst-diminisher" for different loads. The loads result from the accident "Burst of a Pressure-retaining Tube of the Coaxial Conduit" under realistic and pessimistic assumptions and for the performance of both burst and load experiments. The calculations show that the "burst-diminisher" is capable to fulfill its tasks. Thereby are avoided damages of components in the primary circuit (in particular those for removal of after-heat) which might be caused by a too quick pressure relief after the burst of a coaxial conduit. 8 references. (auth)

5389 (CONF-740501-) ANS TOPICAL MEETING ON GAS-COOLED REACTORS: HTGR AND GCFBR, GATLINBURG, TENNESSEE, MAY 7–10, 1974. (American Nuclear Society, Oak Ridge, Tenn.; American Nuclear Society, Hinsdale, Ill.). 1974. 565p. Dep. NTIS $13.60.

Separate abstracts were prepared for 28 of the 29 papers included. An abstract for the remaining paper has previously appeared in NSA. (JWR)

For abstracts of individual papers see: 2850, 2851, 4018, 5390–5406, 5425–5428, 5525–5527, and 5649.

5390 (CONF-740501-, pp 13-33) OPERATION AND MAINTENANCE EXPERIENCE WITH THE DRAGON REACTOR EXPERIMENT. Chapman, B. G. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The vital importance of reliability in nuclear power plants is stressed and the general principles of failure are used to select areas of Dragon operating experience for discussion. This approach emphasizes the need to consider negative as well as positive information and on both counts the Dragon experience indicates that the High Temperature Reactor possesses inherent qualities which favor the achievement of reliability. (auth)

5391 (CONF-740501-, pp 34-49) AVR: HTR OPERATING EXPERIENCE. Ivens, G. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

For over six years the first HTR power station with a pebble bed reactor, the German AVR experimental power station, has operated very satisfactorily. Consequently, during the last two years the main operating objectives have been to carry out experiments and measurements which would promote the further development of this type of reactor. Special importance is attached to the planned increase of the hot gas temperature from 850°C to 950°C. (auth)

5392 (CONF-740501-, pp 50-59) INFLUENCE OF OPERATING EXPERIENCE ON BRITISH GAS COOLED REACTOR DESIGN. Gibbs, K. P.; Tattersall, D. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Some of the design-related problems encountered during the operation of the British gas cooled reactors are described. Some lessons which have been learned relating to design provisions for inspection, monitoring, and repair or replacement of components are discussed. Some suggestions on design requirements for future gas cooled reactors are presented. (JWR)

5393 (CONF-740501-, pp 60-71) FRENCH GAS COOLED REACTOR EXPERIENCE. Stolz, J.; Boudouresques, B. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR.

In gas-cooled reactors: HTGR and GCFBR.

The French gas-cooled reactor program is discussed. Topics covered include design and construction experience, operational experience, and fuel behavior. (JWR)

5394 (CONF-740501-, pp 72-91) COMPARATIVE HTGR-DESIGNS. Oehme, H. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The designs with pebbles and prismatic fuel correspond in most basic features, which establish the advantages of HTGR's. The status of pebble bed reactors is given by the successfull operation of AVR-15 with a maximum gas temperature of 850°C and a maximum burn-up of about 145,000 MWd/to. The THTR-300 prototype is under construction and a THTR-1000 was roughly laid out and is described. Completed designs of HTGR's with prismatic fuel for 770 and 1160 MW power output are available and several orders were received in the US. The designs are based on the experience gained with the 300 MW Fort Saint Vrain reactor-station, which is scheduled for acceptance this year. An HTGR with low enriched fuel is being designed in Great Britain. Both HTGR designs seem to have the same potential up to gas temperatures below 1000°C. Whereas large numbers of full size pebbles were tested, prismated elements were tested in representative sections. Prismatic fuel leads to some relevant advantages with respect to mechanical simplicity of reactor control and inspectability. The design based on prismatic fuel is several years ahead of the pebble bed reactor and offers a realistic chance for international cooperation. (auth)

5395 (CONF-740501-, pp 115-127) EVALUATION OF HTR's FOR EUROPEAN APPLICATIONS. Audinet, M.; Guennec, N.; Pelce, J.; Rastoin, J. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

An examination of the conditions affecting the market for HTGR type reactors in Europe is presented. The development of HTGR type reactors in Europe is also discussed. Conditions governing the fuel cycle and component manufacture in Europe are compared with the U. S. situation. (JWR)

5396 (CONF-740501-, pp 128-145) FUEL MANAGEMENT FLEXIBILITIES OF THE Th–^{233}U CYCLE. Bennett, L. L. (Oak Ridge National Lab., TN); Lane, R. K. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The fuel cycle optimization and management flexibilities of the HTGR with the Th–^{233}U cycle now being commercially offered is examined. Emphasis is on the variation of thorium loading to minimize cost. The highly versatile nature of the fuel cycle is pointed out. (JWR)

5397 (CONF-740501-, pp 146-161) LOW ENRICHED HTR. Insch, G. M.; Joyce, A. J. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Two principal fuel cycles have been proposed for the H. T. R.—the thorium/uranium (Th/U) and the low enriched uranium (L. E. U.) cycles. The first uses over 90% enriched uranium as the initial fissile material, mixed with thorium as the fertile material producing U_{233} which is fed back into the same reactor. The second uses uranium of about 9% enrichment, U_{235} as the initial fissile material and U_{238} as the fertile material producing plutonium. In the U. K., however, the plutonium is usually assumed to be sold for use in a different type of reactor, notably the sodium cooled fast reactor. Some comparisons are made between H. T. R.s using these two fuel cycles, and a design developed in the U. K. to use the L. E. U. cycle is described. (auth)

5398 (CONF-740501-, pp 162-175) HTGR COMPONENT TESTING. Chaboseau, J.; Chapelot, A.; Cornille, Y.; Patarin, L. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Tests on HTGR's components which are carried out within the framework of an R and D program in FRANCE, mainly in cooperation with GENERAL ATOMIC, are described. This program takes advantage of the previous effort made in FRANCE on the components of graphite moderated natural uranium reactors, cooled by CO_2 (UNGG reactors). The UNGG line consists of as many as nine reactors in FRANCE and SPAIN. The components testing has required the construction of very important facilities by three of the interested parties, namely ELECTRICITE DE FRANCE (EDF), COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA) and French INDUSTRY. Many UNGG components were new concepts (PCRV, graphite stack, steam generators, circulators, fuel handling machines . . .). Most of them are found with the required adaptations in the HTGR's. (auth)

5399 (CONF-740501-, pp 176-200) PRESENT THORIUM-CYCLE CONCEPTS AND PERFORMANCE LIMITATIONS. Gulden, T. D. (General Atomic Co., San Diego, CA); Scott, J. L.; Moreau, C. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Fuel for the thorium-cycle HTGR has evolved from the partially segregated fuel used in the Peach Bottom and Fort St. Vrain reactors to complete segregation of fissile and fertile species in separate coated particles for the current generation of large commercial HTGRs. The extensive fuel development and test programs for the early HTGRs provide a technology base for the current fuel. All significant changes from this base technology, which have resulted from efforts to optimize the fuel cycle, have now been successfully demonstrated in irradiation tests to and beyond peak design exposures. The performance of the fuel particles is limited by irradiation-induced mechanical stresses and by chemical reactions, including the amoeba effect. Models are available to describe most of these phenomena with varying degrees of accuracy. Normalization of the models with experimental results provides a firm basis for predicting fuel performance. A number of potential improvements in the coated particle fuel are under investigation both in the United States and Europe. These developments offer significant promise for improving HTGR fuel with respect to performance, fission product retention, and economics. (auth)

5400 (CONF-740501-, pp 201-217) HTGR FUEL DEVELOPMENT AND TESTING. Balthesen, E. (Kernforschungsanlage, Juelich, Ger.); Ehlers, K.; Hackstein, K. G.; Nickel, H. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The German HTR fuel element and graphite development program has the principal objectives of providing, at the appropriate stages of HTR systems development, fuel elements for the operation of the AVR research reactor, for the prototype plant THTR-300 now under construction, and for the planned advanced HTR systems with the integrated helium turbine as well as with the generation of nuclear process heat. Extensive production and irradiation experience has been gained with pyrocarbon coated Th–U-mixed oxide particles. Progress in the manufacturing of molded matrix/fuel-particle compositions has been utilized for the development of fuel elements of different geometries. The successful irradiation behavior of the spherical fuel elements has been confirmed by the results of an extensive irradiation program. The results show a remarkable transferability of the material behavior of different fuel element types. The development potential of these fuel bodies is as yet not exhausted. For graphite block fuel elements, an economical pitch coke based nuclear grade graphite has been selected for an extensive irradiation program. (auth)

5401 (CONF-740501-, pp 218-256) HTR FUEL DEVELOPMENT AND TESTING IN THE DRAGON PROJECT. Graham, L. W.; Price, M. S. T.; Saunders, R. A.; Smith, E. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg,Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

A few basic principles give to the HTR a sound technical basis which is now leading to a realization of the worth and potential of the system. Important among these are a replaceable core structure of graphite, carrying fuels with the minimum of parasitic materials and the use of helium, clearing the way to very high operating temperatures. The Dragon Reactor occupies a unique position in the development of the HTR. Experimental fuel elements have been continuously evolved in parallel with the progress of designs for power reactors. Steady development of fuel by the Dragon Project and the successful operation of many large graphite structures have contributed to the present situation of commercial exploitation of the steam cycle HTR and are also encouraging exploration of the technical problems associated with higher coolant temperatures leading to a VHTR concept. (auth)

5402 (CONF-740501-, pp 378-396) HTGR FOR DIRECT CYCLE AND PROCESS HEAT APPLICATIONS. Kraemer, H. (Kernforschungsanlage, Juelich, Ger.); Arndt, E.; Schlenker, H. V.; Schulten, R.; Barnert, H.; van der Decken, C. B.; Kugeler, K. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

HTR's for direct cycle and process heat are the consequent continuation of the HTR steam cycle line. The nearest application exists in the generation of electricity by direct cycle plants. It is expected to achieve an improvement of the economy in combination with optimal adaption of the future conditions for the discharge of waste heat. An increasing market share of HTR in the nonelectrical field can be seen firstly in the use of the waste heat of HTR steam cycle plants as well as of HTR direct cycle plants for district heating and secondly the use of nuclear process heat either for the production of synthetic gas for consumption or for the transport of latent energy. Development programs both for direct cycle and process heat were sponsored more than two years ago by government of the FRG and the first also by the Swiss government. Partners in the direct cycle program are: BBC, BST, EIR, HRB, KFA, NUKEM, SULZER and EVO and the universities of Aachen and Hannover. Partners in the process heat program are: Bergbauforschung, Rhein–Braun and KFA. The status and the outlook of these applications, the existing and the planned programs and the areas of the expected problems as materials, fission product, test facilities, introduction into the market etc. are treated in the report. (auth)

5403 (CONF-740501-, pp 397-417) DIRECT-CYCLE AND PROCESS HEAT HTGR DEVELOPMENT. Fortescue, P.; Quade, R. N. (General Atomic Co., San Diego, CA). 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The outstanding high-temperature capability conferred by the graphite-structured core of the HTGR and the low activity carried by its helium coolant immediately suggest use as the direct internal heat source so long awaited to secure the closed-cycle gas turbine's special advantage as a power source of remarkable compactness and simplicity. More generally, it offers prospect of a now particularly desired extension of nuclear power's capability to supply industry's pressing need for high-temperature process heat. The basis of claims in the areas is examined with a view to assessing their impact and likelihood of success. In this context interest centers not so much on particular design description, but rather on the total implication of the current studies. (auth)

5404 (CONF-740501-, pp 472-486) FORT ST. VRAIN HTGR OPERATING EXPERIENCE. Walker, R. F. (Public Service Co., Denver). 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Significant milestones in the history of the Fort St. Vrain HTGR are traced from the filing of the construction permit through the issuance of the operating license. Some of the highlights of the construction are described. The startup testing and the rise-to-power program are discussed. (JWR)

5405 (CONF-740501-, pp 487-524) DESIGN AND DEVELOPMENT OF THERMAL INSULATION FOR HIGH TEMPERATURE GAS COOLED REACTORS. Hosegood, S. B.; Jones, H. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Thermal insulation systems for gas cooled reactors have been developed on both sides of the Atlantic. These are described and examples are given from the major programs of testing and development work carried out to ensure high standards of reliability in meeting difficult and sometimes conflicting service requirements. Currently available techniques and materials are adequate for High Temperature Gas Cooled Reactors with steam power plants but improved materials and techniques will be required for the higher temperature levels anticipated in HTGC Reactors for gas turbine and high temperature process heat supply applications. Materials for these more severe conditions are currently being developed. (auth)

5406 (CONF-740501-, pp 525-559) MATERIALS SELECTION FOR GAS-COOLED REACTOR COMPONENTS. Hedgecock, P. D. (General Atomic Co., San Diego, CA); Patriarca, P. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The governing environmental conditions within the High-Temperature Gas-Cooled Reactor (HTGR) are described in relation to the functions of all the major nuclear steam supply system components. Using these descriptions, the rationale underlying the selection of appropriate materials is explained. Special attention is paid to the problems associated with the highest temperature structures such as the thermal barrier and steam generators. Background work on materials used in these structures is summarized and reference is made to studies on the effects of helium impurities on alloys for use in the HTGR. Current and near-term future programs are briefly described. A concluding theme postulates future changes in alloying element availability with the effect that these changes could have on alloy and material development programs. (auth)

5407 (CONF-740501-5) FISSION PRODUCT CONTROL IN HTGR PLANTS. de Nordwall, H. J.; Bell, W. E. (Oak Ridge National Lab., Tenn. (USA)). 1974. 25p. Dep. NTIS $4.25.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

Fission product control in a typical 2000 MW(t) HTGR plant is discussed in terms of (1) radiation dose guidelines as established by the AEC, (2) fission product pathways to the environment, (3) fission product distributions under normal and selected accident conditions, and (4) the physical models and basic data used to describe fission product transport. Six key fission product nuclides, namely ^{3}H, ^{85}Kr, ^{90}Sr, ^{127m}Te, ^{131}I, and ^{137}Cs are taken to represent chemically and radiologically all significantly mobile fission products. Results of release calculations for the six nuclides show substantial margins (or safety factors) between acceptable (guideline) and predicted releases to the environment. For normal conditions, the smallest apparent margin, a safety factor of 22, is for ^{85}Kr. For accident conditions, the smallest apparent safety factor is 330, which is for ^{90}Sr in the design depressurization accident. (43 references) (auth)

5408 (GA-A-12885) STATUS OF GRAPHITE TECHNOLOGY AND REQUIREMENTS FOR HTGRs. Engle, G. B.; Everett, M. R.; Eatherly, W. P. (General Atomic Co., San Diego, Calif. (USA)). 28 Feb 1974. Contract AT(04-3)-167. 19p. (CONF-740501-3). Dep. NTIS $4.00.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

The current status of graphite technology related to core graphites for large HTGRs is discussed. The graphite data are reviewed for: anisotropic needle-coke, near-isotropic coke, and high-strength, fine-grained isotropic graphites. Near-isotropic graphites are currently undergoing extensive evaluation in Europe and the U. S; these materials should permit longer core life at higher temperatures. Property measurements, irradiation experiments, and experimental/theoretical studies that are being conducted are described briefly. (DLC)

5409 (GKSS-74-E-6) TEMPERATURE DISTRIBUTION IN THE ELEMENTARY CELL OF THREE INTEGRAL BLOCK TYPE FUEL ELEMENTS OF DIFFERENT GEOMETRY. Penndorf, K.; Schult, F. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1974. 16p. (CONF-730355-1). Dep. NTIS (U. S. Sales Only) $4.00.

From Dragon countries physics meeting; Julich, F. R. Germany (22 Mar 1973).

Two-dimensional temperature fields in the elementary cells of two variants of the integrated block element are calculated under stationary state conditions of an HHT-reactor. The results are compared with those obtained from the GGA block elementary cell. (GE)

5410 SYSTEM FOR POWER MONITORING OF FUEL CHANNELS AT UNIT II OF THE BELOYARSK ATOMIC POWER PLANT. Dubovskii, B. G.; Evseev, A. Ya.; Ezhov, V. V. At. Energ. (USSR); 36: No. 3, 171-173(Mar 1974). (In Russian).

The main design and experimental parameters of a system for power monitoring of fuel channels at Unit II of the Beloyarsk Power Plant are presented. Rhodium self-powered detectors, mounted in the central orifice of steam superheating channels at a working temperature of up to 700°C, were used as sensors for this system. Currents in the ranges 0-15 and 0-3 μA with basic errors of ± 1.5 and ± 2.5%, respectively, can be measured. The sensitivity of the detectors is (7.8 ± 0.6) $A \cdot cm^2 \cdot s$/neutron for thermal neutrons and (19.8 ± 1.8) $A \cdot cm^2 \cdot s$/neutron for epithermal neutrons. The error in determining the sensitivity of the self-powered detectors, as well as of the fuel channel power detectors, does not exceed ±8% of the absolute value $\gamma = 61 \pm 5$ kW/μA. The value was constant over a period of 54 months within an experimental accuracy of about 5%. The maximum error in determining the power of the fuel channel, in which the self-powered detector is located, is ±9%. The plant guarantee term for self-powered detectors is one year and a reliability probability $P^* = 0.8$. In fact, during ordinary operation of this system, for various reasons about 10% of the detectors fail. (4 figures, 2 references) (auth)

5411 1160 MWe NUCLEAR POWER STATION PROJECT WITH HIGH-TEMPERATURE REACTOR. Roehler, E.; Schloesser, J.; Tegen, W.; Thurnher, K. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Brown Boveri Rev.; 60: No. 9, 377-388 (Sep 1973).

Nuclear power plants will have to be used increasingly in the future to provide an economical and dependable supply of electricity. Power stations of this kind have to meet progressively more exacting demands as regards pollution control and safety. The design of the high-temperature reactor and the nature of its operating process make it particularly well suited to meet these requirements. The evolution of high-temperature reactor technology in Germany is reviewed briefly, and a thoroughly developed project for a high-temperature reactor plant is described in detail. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 5358, 5363, 5364, 5382, and 5625.

5412 (AECL-4709) WHY CANDU? ITS ACHIEVEMENTS AND PROSPECTS. Gray, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ont. Chalk River Nuclear Labs.). Jan 1974. 18p. Dep. NTIS (US Sales Only) $4.00. AECL $0.50.

The CANDU/PHW reactor is commercially viable under many conditions and it is technically acceptable. The simple construction using pressure tubes and the simple, low cost fuel cycle are attractive to many countries. The performance of the 2000 MWe Pickering Station has demonstrated many of the claims for this system and the large Canadian program ensures adequate support for continued success. Future development offers improvement to the PHW version and other coolants offer prospects of lower capital costs and higher efficiencies. (auth)

5413 (CEA-CONF-2528) BEHAVIOR OF FUEL ELEMENTS WITH ZIRCONIUM ALLOY JACKET OPERATING AT HIGH TEMPERATURE; ELEMENT EL4 Zr–Cu. Ringot, C.; Orsier, G. 1973. 15p. (In French). (CONF-731004-10). Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

The behavior of fuel elements clad with a Zr–Cu alloy was tested in the EL-4 reactor from its start-up. The burn-up forseeable for a maximum temperature of 600°C was determined for this type fuel with a determination of the stresses placed on the element during its lifetime. The fissures induced by thermal cycling were limited in depth to the depth of the zone contaminated by oxygen. The maximum operational temperatures in the EL4 for these fuel elements were determined. The limitations placed on the fuel elements by the reactor operating conditions were described. The optimum burn-up was chosen as 20,000 MWd/t. The characteristics of the fuel element adopted for the EL4 on the basis of these studies were tabulated. (JSR)

5414 (CONF-730942-P4, pp vp Paper K 7/3) FINITE ELEMENT ANALYSIS OF THIN-WALLED STRUCTURES WITH APPLICATION TO STRUCTURAL PROBLEMS IN REACTOR TECHNOLOGY. Kawai, T. (Tokyo Univ.); Muraki, T.; Toyoshi, T. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Vibration and response analysis of a fuel charging machine of a nuclear reactor is presented. The main features of the present method can be summarized as follows: a new stiffness matrix of a beam element for warping-torsion is derived by using the 3rd order polynomial; 3D stiffness matrix of a beam element whose nodal points may be arbitrarily taken on each end section can be derived by following standard matrix transformation procedure, transformation matrix of which is derived from the basic displacement function assumed in the modern theory of a thin-walled beam; a method of calculation on the stiffness increase of a beam element due to various stiffening members or stiffness reduction due to cut-outs is proposed; and effects of deformation of a beam cross section as well as shear deformation on the beam deflection will be successfully made by a finite element method based on the extended St. Venant's semi-inverse method. 12 references. (auth)

5415 (IAEA-126, pp 179-212) DESIGN PHILOSOPHY AND CRITERIA OF SAFETY FOR PRESTRESSED CONCRETE PRESSURE VESSELS: PRACTICE IN CZECHOSLOVAKIA. David, M. (State Design Inst., Prague). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

The main conclusions and results of about three year's work in Czechoslovakia in development of PCPV's are described with particular reference to the design philosophy and criteria of safety. Development was made for gas-cooled reactors of 500 MW(e) with heat exchangers placed inside the PCPV's. The most difficult problem of the structural design was to find an appropriate method for solving requirements of the fine mesh of penetrations together with extremely high internal working pressure (80 kg/cm^2). Various small scale models of elastic materials in the scale of about 1 : 40 were investigated and methods of

measurement of strains and photo-elasticity were employed. The program which is proposed for the short model is described and the estimation of cost of PCPV's is discussed in general terms. (auth)

5416 (INIS-mf-1145) COMMISSIONING CHEMISTRY OF THE ORDINARY WATER, HEAVY WATER, AND GASEOUS SYSTEMS OF THE FIRST UNIT OF THE RAJASTHAN ATOMIC POWER STATION. Nair, B. K. S.; Ghosh, G. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 12p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Included are discussions of the following topics: the hot conditioning of the high-pressure, high-temperature, primary heat transport system with ordinary water; flushing and filling the moderator system; observations on the chemistry and problems associated with chemistry during commissioning and subsequent operation of the major systems; chemical control measures adopted and evaluation of their effectiveness; interpretations, suggestions, and conclusions based on the above information. (auth)

5417 (TRITA-EPP-74-7) BOUNDARY LAYER BETWEEN A ROTATING PLASMA AND A NEUTRAL GAS BLANKET. Hellsten, T.; Raggi, R. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Feb 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

The boundary layer situated between a rotating hydrogen plasma of high density and a surrounding neutral gas has been investigated by means of electric probes. The measured parameters are the electric field, the plasma density and the electron temperature. The boundary layer has a "fine structure" defined by four limits: (1) the innermost limit is characterized by the fact that the velocity of rotation reaches the critical value v_c, (2) the second limit is defined by the magnetic field lines touching the cathode plate, which acts as a strong plasma sink, (3) at the third limiting surface the rotation velocity decreases to zero, and (4) at the fourth limit the recombination processes become important, and the plasma density decreases abruptly in the radial direction. (auth)

5418 FIRST CZECHOSLOVAKIAN ATOMIC POWER PLANT A-1 WITH HEAVY-WATER GAS COOLED REACTOR KS-150 CONSTRUCTION, START-UP, AND INITIAL OPERATION EXPERIENCE. Abramov, V. M.; Batyrov, B. B.; Bogdanov, N. V. At. Energ. (USSR); 36: No. 3, 163-170(Mar 1974). (In Russian).

Some data on complex tests, and start-up and initial operation experience are also given. The advantages of this type of reactor are considered. (5 figures, 4 tables, 2 references) (auth)

5419 WINFRITH STEAM GENERATING HEAVY WATER REACTOR. Chaplin, R. A. (Electricity Supply Commission, Johannesburg). S. Afr. Mech. Eng.; 23: No. 5, 82-96(May 1973).

A descriptive outline is presented of the British developed SGHWR which has been built by the UKAEA at Winfrith, Dorset, as a prototype nuclear generating station. The station has been in operation for several years and has been a testing ground for future developments as well as an electric power producer. (auth)

5420 POWER IN ONTARIO. Mod. Power Eng.; 67: No. 12, 41-56(Dec 1973).

The success with which Ontario Hydro has been shifting its utilities to a nuclear basis during 1973 and highlights of its future expansion program are discussed. Major nuclear highlights include the doubling of both the Pickering and Bruce nuclear plants and the construction of the new Darlington plant with four 750 MW units. Design features which have contributed to the success of Pickering, such as heavy water recovery and upgrading systems, and modifications being embodied in the Bruce plant (containment, fuelling systems) are reviewed. The status of design, mechanical, electrical and construction phases of the Bruce plant are summarized as well as the operation of the Bruce heavy water plant. The design of the 540 MW steam turbines and turbogenerators of the Pickering generating station is described along with the further innovations to be introduced into the Bruce turbogenerators. (CA)

5421 NUCLEAR REACTOR FUEL ELEMENT. Knoedler, D. (to Siemens AG). German(FRG) Patent 2,204,168. 2 Aug 1973. 9p. (In German).

The described fuel element support is especially designed for fuel elements of heavy water moderated reactors. The fuel element consists of many fuel rods which are fixed to a rod holding plate. The fuel element consists of several part fuel elements which are held together by a central carrier device on which they can be converted and arranged on top of one another. The technical details of the support of these part fuel particles are part of the patent. (GE)

Power Reactors, Breeding

Refer also to abstracts 2786, 4063, 5358, 5365, 5389, 5525, and 5621.

5422 (AI-AEC-13126) LMFBR IN-VESSEL STORAGE REFUELING COMPONENT DEVELOPMENT PROGRAM. Quarterly Technical Progress Report, January–March 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 15 May 1974. Contract AT(04-3)-824. 15p. AT.

Progress in the development and testing of handling devices for core components for an LMFBR plant with under-the-shield refueling and reactor vessel cover rotating plugs is reported. The devices include an in-vessel transfer machine, an ex-vessel transfer machine, an auxiliary handling machine, floor valves, and core component service equipment. (JWR)

5423 (BLG-481) ANNUAL SCIENTIFIC REPORT, 1972. Billiau, R.; Bobin, K.; Drent, W.; Hespeels, L. (eds.). (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. vp. INIS.

The report summarizes the main activities of SCK/CEN during 1972. Topics discussed include: development of fast reactors; operation experience with BR-1, BR-2 and BR-3 reactors; gas cooled and high temperature reactors; solid state physics; nuclear physics; radiobiology; safety studies; production and application of actinium; radiochemistry; waste processing and disposal; and fuel cells. (auth)

5424 (CONF-730942-P4, pp vp Paper K 5/4) AMBIENT VIBRATION SURVEY ON THE CONTAINMENT STRUCTURE OF PEC REACTOR. Milella, P.; Perinetti, M.; Zaffiro, C. (CNEN, Rome). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A new experimental method is described, which has been employed to verify some dynamic calculations for the containment system of PEC (Prova Elementi Combustibili) Reactor near Bologna. This method is named AVS (Ambient Vibration Survey) and has been developed in USA by Teledyne Co. It consists in evaluating the dynamic response of a structure to environmental factors such as wind, earth microtremors, traffic, etc. The response to the motion caused by all these factors was measured on the structure by means of very sensitive seismometers. Data were stored in a magnetic tape recorder and processed in the computer. The recorded motion was analyzed by using spectral techniques; in fact it is known that the direct power spectral density of each recorded motion yields estimates of natural frequencies and modal damping, whereas a cross spectral density between a reference record and all other records yields mode shape estimates. The results of AVS were compared with those performed on a scale-model in laboratory and those performed on the real structure by means of a vibrodyne. At least all these experimental results were compared with the results of calculations obtained by means of a computer program. 4 references. (auth)

5425 (CONF-740501-, pp 306-317) PROGRESS OF THE GBR ASSOCIATION IN THE DESIGN AND DEVELOPMENT OF THE GAS-COOLED FAST BREEDER REACTOR. Yellowlees, J. M.; Burgsmueller, P.; Chermanne, J. (GBR Association Study Group, Brussels). 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Research and development on gas cooled breeder reactors by the European Association for the Gas Breeder Reactor is described. The design of the GBR-4, a 1200 MW(e) helium-cooled fuel-pin type reactor, is described in some detail. (JWR)

5426 (CONF-740501-, pp 319-335) GAS-COOLED FAST BREEDER REACTOR DESIGN, DEVELOPMENT, AND SAFETY FEATURES. Dalle Donne, M. (Kernforschungszentrum, Karlsruhe, Ger.); Goetzmann, C. A. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The conclusions of an evaluation study of the GCFBR performed by the two German Nuclear Centers and the German nuclear industry are presented. Following these conclusions a joint R and D program between the two German Nuclear Centers at Karlsruhe and Jülich and the German firm KWU was decided. This refers to a GCFBR with helium cooling, steel clad vented pins, oxide fuel and steam turbine cycle, similar to the General Atomic concept. The two main items of this program are: an irradiation test of a 12 vented pin bundle in a high pressure helium loop in the Belgian

reactor BR2 at Mol to be started in 1975; and a study on the design and safety aspects of a 1000 MW(e) GCFBR. The first results of this study indicate that this reactor can be designed to meet the safety requirements currently in use in Germany. (auth)

5427 (CONF-740501-, pp 336-354) GAS-COOLED FAST BREEDER REACTOR DEMONSTRATION PLANT. Simon, R. H. (General Atomic Co., San Diego, CA); Dee, J. B.; Morita, W. I. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The design of a 300 MW(e) Gas-Cooled-Fast-Breeder Reactor Demonstration Plant is described along with the development and test program required to design, construct and verify the performance of the components for the plant. Costs and schedules are also discussed. (auth)

5428 (CONF-740501-, pp 355-377) GAS-COOLED FAST BREEDER REACTOR FUEL DEVELOPMENT. Weinberg, A. F. (General Atomic Co., San Diego, CA); Neimark, L. A.; Fitts, R. B.; Markoczy, G. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Although the major operational parameters of the GCFR fuel element are similar to those used for LMFBR elements, the use of pressure-equalized and vented fuel rods, cladding surface roughening, fuel-rod spacer grids, and a gas coolant requires a comprehensive development program. Analytical and experimental heat-transfer programs have established initial design points, so consideration is now turning to the effects of operational parameters under design, off-normal, and transient conditions. Thermal-flux and fast-flux fuel-rod irradiation programs in progress are proving the pressure-equalized and vented rod concept and a twelve-rod-bundle test is under construction. Trade-off studies indicate that future development work should be focused on increasing the cladding temperature and fuel-rod burnup. (auth)

5429 (COO-2245-7) COOLANT MIXING IN LMFBR ROD BUNDLES. Quarterly Progress Report, September 1–November 30, 1973. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 21 Jan 1974. Contract AT(11-1)-2245. 32p. Dep. NTIS $4.00.

Experiments on bundle geometry for wrapped and bare rock and on subchannel geometry for bare rods are reported. Developments of analytic models for both bundle and subchannel geometries are also reported. (JWR)

5430 (COO-2250-5) EVALUATION OF THE PARFAIT BLANKET CONCEPT FOR FAST BREEDER REACTORS. Ducat, G. A.; Driscoll, M. J.; Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jan 1974. Contract AT(11-1)-2250. 265p. (MITNE-157). Dep. NTIS $16.25.

An evaluation of the neutronic, thermal-hydraulic, mechanical and economic characteristics of fast breeder reactor configurations containing an internal blanket has been performed. This design, called the parfait blanket concept, employs a layer of axial blanket fuel pellets at the core midplane in the fuel pins of the inner enrichment zone; otherwise, the design is the same as that of the conventional LMFBR's to which the parfait configuration was compared. Two significant advantages were identified for the parfait blanket concept relative to the conventional design. First, the parfait configuration has a 25% smaller peak fast flux which reduces wrapper tube dilation by 37% and fuel element elongation by 29%; and second, axial and radial flux flattening contribute to a 7.6% reduction in the peak fuel burnup. Both characteristics significantly diminish the problems of fuel and metal swelling. Other advantages identified for a typical parfait design include: a 25% reduction in the burnup reactivity swing, which reduces control rod requirements; a 7% greater overpower operating margin; an increased breeding ratio, which offsets the disadvantage of a higher critical mass; and more favorable sodium voiding characteristics which counteract the disadvantage of an 8% smaller power Doppler coefficient. All other characteristics investigated were found to differ insignificantly or slightly favor the parfait design. (auth)

5431 (DEU-73-29) THIRD MILLENIUM HAS (ALREADY) BEGUN. (Schnell-Brueter-Kernkraftwerksgesellschaft m.b.H. (SBK), Essen (F. R. Germany)). [nd]. 16p. (In German). INIS.

The whole view and sectional view of the reactor building is given for the planned SNR reactor plant Kalkar. The economical and functional advantages of breeder nuclear power plants as well as the comparable large safety and relative harmlessness of nuclear power plants due to given measures are emphasized. A list of the German nuclear power plants (in operation and being planned or built) with the operator's specifications, of the capacity and reactor type, concludes this generally comprehensive work. (GE)

5432 (FEI-399) LARGE POWER FAST REACTORS WITH JOINT UTILIZATION OF U-235 AND PLUTONIUM. Ilyunin, V. G.; Kuz'min, A. M.; Murogov, V. M.; Orlov, V. V.; Silaev, Yu. V.; Troyanov, M. F.; Shemelev, A. N.; Yurova, L. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.25.

The characteristics of fast reactors using both ^{235}U and Pu are examined. The results of a numerical study showing the efficiency of the combined use of ^{235}U and Pu in the same reactor are reported. (tr-auth)

5433 (GEAP-13825-8) INSTRUMENTATION DEVELOPMENT EIGHTH QUARTERLY REPORT, OCTOBLR–DECEMBER 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jan 1974. Contract AT(04-3)-893. 24p. AT.

This is the eighth in a series of reports covering the development of instrumentation for surveillance of the core and in-vessel components of liquid metal fast breeder reactors. Current development efforts are focused on high temperature neutron detectors and reactivity monitoring systems. (auth)

5434 (GEAP-13986) CORE RESTRAINT SYSTEM TESTS AND ANALYSIS. Phase III. Planar Externally Clamped Large Core. Meserve, C. E. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Dec 1973. Contract AT (04-3)-893. 54p. AT.

Tests of a core restraint system employing external yokes to load and to compact the reactor core were conducted using the HEDL Planar Clamping Model after it had been extensively modified to accommodate a 361-channel core. Important characteristics of the hexagonal channel array subjected to inward directed loads were observed and measured. The tests demonstrated the ability of the externally clamped restraint system to function on a larger core with a high interchannel coefficient of friction. The necessity for tight manufacturing tolerances on the across-flats dimension at the load pad regions of full size channels is evident from an examination of the data obtained. (auth)

5435 (HEDL-SA-701) MICROSTRUCTURAL DEPENDENCE OF FAILURE IN MIXED-OXIDE LMFBR FUEL PINS. Scott, J. H.; Culley, G. E.; Hunter, C. W.; Hanson, J. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2170. 29p. (CONF-740401-6). Dep. NTIS $4.50.

From conference on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

Failure and post-failure behavior of mixed oxide fuel pins during transient overpower conditions has been the subject of intensive testing for several years. Analyses of mixed oxide fueled fast reactor overpower transients have shown that time and location of initial fuel pin failure may have an important effect on the accident progression. The more recent tests at ANL and HEDL have been focused on behavior of FTR prototypic fuel pins irradiated in EBR-II. The experimental data from the testing of fuel pins in-reactor and the testing of irradiated cladding specimens ex-reactor is reviewed and an empirical correlation consistent with experimental evidence to date is proposed. This correlation relates failure thresholds to fuel microstructures and local cladding conditions. (auth)

5436 (PMC-74-1) PROCEEDINGS OF BREEDER REACTOR CORPORATION JANUARY 1974 INFORMATION SESSIONS ON THE CLINCH RIVER BREEDER REACTOR PROJECT. (Breeder Reactor Corp., Knoxville, Tenn. (USA)). Apr 1974. 121p. (CONF-740116-). AT.

Topics discussed include project status, design philosophy, program support at FFTF and other facilities, reactor systems, primary heat transport system and plant control, intermediate sodium system and steam generator system, refueling and auxiliary systems, turbine generator system, and civil engineering aspects and site considerations. (JWR)

5437 (WARD-5224) PLASTIC COLLAPSE LOADS FOR PIPE ELBOWS USING INELASTIC ANALYSIS. Mello, R. M.; Griffin, D. S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.; Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Dec 1973. Contract AT(11-1)-3045. 32p. (CONF-740606-11). Dep. NTIS $4.75.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

The results of an inelastic analysis are used to predict plastic collapse loads for in-plane bending of several pipe elbows. The analysis is made using a nonlinear finite element computer program which takes into account the effects of material strain hardening, stress redistribution, and ovalization of the elbow cross section. Various methods are used to determine plastic collapse loads based on the calculated load-deformation curves. The predicted collapse loads are compared to collapse loads determined by limit analysis and the method described for plastic analysis in Section III, Appendix F, of the ASME Boiler and Pressure Vessel Code. It is concluded that the current Code definition of collapse load is overly conservative for structural materials typical of high temperature application, and that the .2% offset method or the 2 times the angle of linear response method produce more realistic results. (auth)

5438 (WARD-5261) UNITED STATES LMFBR DEMONSTRATION PLANT ACTIVITIES. Behnke, W. B.; Crawford, J. W.; Jacobi, W. M.; Watson, J. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. Contract AT(11-1)-2395. 40p. (CONF-740318-1). Dep. NTIS $5.00.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

The principal objectives of the LMFBR demonstration plant program are discussed. Some of the background and key events chronology is reviewed. The program planning and project organization is summarized. The site selection is discussed and the project schedule is presented. (JWR)

5439 (WARD-CR-3045-5) CORE RESTRAINT DEVELOPMENT. Quarterly Progress Report for Period Ending February 28, 1974. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Apr 1974. Contract AT(11-1)-3045. 11p. AT.

All electrical measuring instruments were calibrated, functionally tested, and made ready for characterization testing. The signal conditioning electronics for the Instrumented Simulated Fuel Assembly (ISFA) units and the cabling for this system has been installed. The enclosure for the Core Restraint Test Facility is designed and under construction. Installation and checkout of the Simulated Fuel Assembly Alignment Fixture has been completed. The hardwood floor for the Duct Bow instrumentation mounting has been completed. (auth)

5440 SOME ASPECTS OF FUEL-PIN-FAILURE PROPAGATION IN SODIUM-COOLED FAST REACTORS. Fauske, H. K. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 1, 10-17 (May 1974).

Some aspects of pin-to-pin failure propagation in a sodium-cooled fast-reactor subassembly resulting from (a) fission-gas release, (b) a local blockage, and (c) release of small amounts of molten fuel are discussed. The consequence of a severe flow dilution due to fission-gas release from a highly burned-up fuel pin is shown to give rise to only minor overheating because of the strong effects of fuel heat capacity, radial heat conduction, and mixing. Analysis has also shown that the occurrence of local boiling due to local blockage of detectable size appears unlikely to lead to dryout and flow instability because of the large subcooling effect in the wake downstream of the blockage. Moreover, even if a pin in a fuel assembly is assumed to fail and release small amounts of molten fuel, calculations indicate that heat losses and condensation will prevent any significant pressure generation and void propagation and therefore reduce the likelihood of rapid failure propagation. (auth)

5441 LIQUID METAL FAST BREEDER REACTOR. An Environmental and Economic Critique. Cochran, T. B. Baltimore; Johns Hopkins Press (1974). 283p. $6.95.

A critical review of the economic and environmental arguments offered in favor of an early introduction of the LMFBR as a central component of the electric power system of the United States is presented. Issues examined include the choice of discount rate, LMFBR generating costs, uranium supply and demand, electrical energy demand forecasts, other economic considerations, environmental impact, and safety aspects. It is concluded that the arguments in favor of the LMFBR are unjustified. (JWR)

5442 ANALYTICAL METHOD OF EVALUATING THE EFFECT OF ROD DISPLACEMENT ON CIRCUMFERENTIAL TEMPERATURE AND HEAT FLUX DISTRIBUTIONS IN TURBULENT FLOW THROUGH UNBAFFLED ROD BUNDLES. Hishida, H. (Mitsubishi Atomic Power Industries, Inc., Omiya City, Japan). Nucl. Eng. Des.; 26: No. 3, 408-422(1974).

An analytical method of evaluating the circumferential variations of temperature and heat flux fields inside and around a displaced fuel rod in triangular rod bundles in turbulent flow is presented with illustrative examples. The analysis consists mainly of the derivation of the simultaneous solutions of a set of heat conduction equations for fuel, cladding and coolant under the assumption of fully developed flow and heat transfer conditions. The local coolant velocity distribution, which is necessary for deriving the temperature field in coolant, is determined by solving the Navier–Stokes equation and the turbulent mixing of coolant is taken into consideration. The results show how the circumferential variations in the temperature and heat flux fields on the outer surface of the cladding increase the lower the P/D ratio and the larger the fuel rod displacement due to thermal conduction and peripheral coolant flow velocity distribution. 13 references. (auth)

5443 HEAT TRANSFER IN LMFBR FUEL ELEMENTS. Part II. Effects of Fuel Pellet Cracks, Granular Fuel Structure, and Azimuthally Non-Uniform Heat Transfer from Cladding to Bulk Coolant. Barrett, P. R. (Univ. of New South Wales, Kensington, Australia). Nucl. Eng. Des.; 26: No. 3, 388-403(1974).

Assuming that cross sections of fuel pellet cracks in liquid metal fast breeder reactor fuel elements may be approximated, for a plane passing through the fuel element axis in the case of axial cracks and for a plane perpendicular to this axis in the case of radial cracks, by narrow triangular slits, it is shown that even for severe cracking the temperature distribution is little influenced by cracks. The problem of the statistical effects introduced by the granular structure of the mixed oxide fuel is examined for LMFBR fuel pellets in which the temperature variation across a pellet is so large that the temperature feedback introduced into the calculation of granular effects by the temperature dependence of thermal conductivity of the fuel zones cannot be neglected. Finally, by means of a linearization approximation the azimuthal dependence of the expected moments of the temperature distribution introduced by azimuthally variable heat transfer from cladding to coolant is discussed in terms of a Fourier synthesis with respect to the angle of azimuth. 8 references. (auth)

5444 HEAT TRANSFER IN LMFBR FUEL ELEMENTS. Part I. Effects of Fuel Pellet Displacement. Barrett, P. R. (Univ. of New South Wales, Kensington, Australia). Nucl. Eng. Des.; 26: No. 3, 376-387(1974).

Random displacement of mixed oxide fuel pellet axes from the central axis of their overall liquid metal fast breeder reactor fuel element occurs when the pellets are randomly loaded within the fuel element cladding sheath. Assuming azimuthally symmetric heat transfer from the outer cladding surface to the bulk coolant, the influence of this random displacement upon the temperature distribution throughout the fuel element is examined when the granular or porous detailed fuel structure and cracks in the fuel are ignored. It is shown that for a typical example, in which the maximum displacement is only 0.0075 cm and the fuel pellet radius is 0.2465 cm, the variance of the maximum fuel temperature is in the vicinity of 115°C, so that this random displacement effect can be quite important especially for those fuel pellets with an expected maximum temperature near the melting point of the fuel. 15 references. (auth)

5445 ROLE OF ADVANCED CONVERTERS AND FAST REACTORS. Report to Session 6. Stewart, J. C. C.; Wolff, P. H. W.; Vaughan, R. D.; Waddams, J. A. London; British Nuclear Forum (1973). 10p.

From fifth foratom congress on nuclear power plant in Europe: yesterday, today, tomorrow; Florence, Italy (14 Oct 1973).

Plans to be undertaken in the UK if Europe is to establish itself in supplying reactor systems in the future are described. The sodium cooled fast reactor (SFR) and the high temperature helium cooled reactor (HTR) are used to illustrate some of the problems to be expected in commercially exploiting new reactor systems. The Pu supply position is discussed. Key issues in changing from the 250 MW(e) PFR to a 1000 MW(e) reactor and also the commercial problems involved in introducing the SFR into the electric utility system are considered. It is concluded that plant manufacturers must aim at forming financially powerful groups capable of international operation. The advantages of the HTR system are discussed and future concepts based on this system are considered. The urgency of formulating common specifications is stressed as a first step to an integrated European approach to an HTR utility. (UK)

5446 FAST BREEDER REACTOR: ENERGY SOURCE FOR THE FUTURE. Balent, R.; Beeley, R. J. (Atomics International, Canoga Park, CA). Energy Sources; 1: No. 2, 189-200(Win 1974).

Nuclear power plants already on the drawing boards can meet the electrical energy requirements of the U. S. and the world for the foreseeable future. The thermal neutron reactors being built today fulfill a short-term need for nuclear energy and will con-

tinue to be built and used until low-cost uranium is no longer readily available. It is likely that uranium prices will accelerate the switch to fast breeder reactors during the 1980's and 1990's. The fast breeder reactor requires very little uranium for its operation and is insensitive to its cost. Uranium already mined would supply the fast breeder reactor requirements for several decades; available resources, at a cost which fast breeder reactor operation can readily afford, will meet our electrical requirements for centuries. (auth)

5447 STATUS AND SAFETY ASPECTS OF THE 300-MW(e) GCFR DEMONSTRATION PLANT. Milioti, S. J.; Larrimore, J. A. (American Electric Power Service Corp., New York). J. Inst. Nucl. Eng.; 15: No. 1, 19-24(Jan 1974).

From American power conference; Chicago, IL (May 1973).

Progress in the design and development of the Gulf General Atomic 300 MW(e) Gas-cooled Fast Breeder Reactor is described, including safety aspects. It is considered that the GCFR offers an attractive and viable alternative to the liquid metal fast breeder reactor, and operation and maintenance features appear promising. The reactor shares many features with the HTGR and LMFBR, making it more attractive than any other alternative breeder, and it may have advantages that offer good assurance of success in achieving the national breeder goal. Progress highlights are summarized, and results from extensive safety studies are stated to be very encouraging. (UK)

5448 PROSPECTS FOR THE BRITISH FAST REACTOR. II. The Messianic Fast Reactor. Campbell, R. H. (Nuclear Power Group Ltd., Knutsford, Eng.). Electron. Power; 20: No. 7, 276-279(18 Apr 1974).

From 16th Hunter memorial lecture; London, Eng. (7 Feb 1974).

The economic reasons for the introduction of fast reactors in the United Kingdom are given. After a brief description of the PFR it is concluded that fast breeder reactors have a large and important part to play in the energy field both in the U. K. and in the world generally for at least three decades. (UK)

5449 PROSPECTS FOR THE BRITISH FAST REACTOR. I. The Current Energy Gap. Campbell, R. H. (Nuclear Power Group, Knutsford, Eng.). Electron. Power; 20: No. 6, 244-247 (4 Apr 1974).

Having reviewed the possible alternative sources of energy which might be available to fill the probable energy shortage, the question as to whether nuclear power generated electricity can provide a much larger proportion of energy demand than it does at present is considered. The trends of use of gas, coal, oil and electricity in domestic, industrial, transport and other sectors are shown from which it appears there is considerable scope for growth in electrical energy demand. The cost and environmental problems of the various alternatives for electricity generation are discussed. (UK)

5450 TOPOLOGICAL ASPECTS OF HEXAGONAL NETWORKS REPRESENTING EQUIVALENT TRUSSES FOR THE SIMULATION OF ROD BUNDLE DEFORMATION UNDER TRANSVERSE LOADING. Zehlein, H. (Kernforschungszentrum, Karlsruhe, Ger.). Atomkernenergie; 23: No. 1, 44-49(1974). (In German).

Certain types of accidents within a fast breeder reactor may lead to permanent deformations of the fuel rods, to reactivity changes and to danger for the safety system. Therefore the simulation of the deformation of rod bundles under transverse transient loading is an important part of the dynamic structural analysis for a FBR-core. It is proposed to use the idea of a tension-free ersatz-truss to model the force diffusion and distribution within the bundle section. Typical characteristics of hexagonal nets are illustrated for setting-up the model automatically. An automatic mesh generator is described. (GE)

5451 FUEL PIN FOR A LIQUID METAL COOLED FAST BREEDER REACTOR. Niemark, L. A. (to United States Atomic Energy Commission). German(FRG) Patent 2,303,992. 2 Aug 1973. 9p. (In German).

The described fuel rod contains numerous ceramic fuel pellets of UO_2-PuO_2, which form the fuel zone within the cladding tube, and numerous ring-shaped ceramic jacket pellets of depleted UO_2, which form an upper jacket arranged in the cladding tube above the fuel zone. A grid support plate for the upper jacket contains a conical jet which increases the axial movement of the fuel and prevents the returning movement of the fuel should the fuel melt as a result of the reactivity insertion or power increase. The exact measures of the jet are given. (GE)

5452 INTERCOMMUNICATION AND ORDER TRANSMISSION: APPLICATION TO PHENIX NUCLEAR POWER STATION. Lafay, F. Electron. Microelectron. Ind.; No. 177, 39-42(1 Oct 1973). (In French).

The size of the Phenix installations leads to the requirement of permanent communication means between the different working parts of the installation and the control centers from which they are operated. The centralization of operational information, its immediate diffusion, and the calling of certain specialists to given places in the installation are accomplished using a double intertelephone network and a high power loud-speaker system. The electronic units, which operate independently of one another, guarantee a high level of operational safety. The size of the two installations and their poor acoustical characteristics have led to numerous problems, above all in the matter of obtaining a perfect intelligibility. This intelligibility was verified using logons as was the case for Rapsodie. (FR)

5453 APPLICATION OF GAS-COOLED REACTOR TECHNOLOGY TO THE FAST BREEDER CONCEPT. Fortescue, P. (Gilf General Atomic, Inc., San Diego, CA). Ann. Nucl. Sci. Eng.; 1: No. 1, 21-29(Jan 1974).

The general objectives underlying the interest in fast breeder reactors at Gulf General Atomic Co. is discussed and the advantages of an FBR-HTGR combination are explained. The interest is centered on the association of pure Th-^{233}U-cycle HTGR power producers with Th-blanketed fast breeders used as ^{233}U fuel-factories, operating with self-sustaining Pu-^{239}U cores, all surplus conversion being devoted to ^{233}U production from suitably blanket-located Th. The advantages of gas-cooling for the breeder are discussed. A brief outline is given of a 300 MW(e) GCFR demonstration plant, and special features of the GCFR design are considered particularly those relating to the fuel element, selection of coolant and its order of working pressure, and containment. (UK)

5454 BREEDER REACTORS. Carle, R. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Fr. Energ.; 25: No. 257, 117-120 (Oct 1973). (In French).

The current state of development of the French breeder reactor program is presented. The preliminary results obtained with Phenix are then discussed together with the objectives of the Super-Phenix program. The industrial problems associated with the development of Super-Phenix are mentioned and the economical aspects of this type of reactor discussed. (FR)

5455 DEVELOPMENT OF ADVANCED POWER GENERATION IN JAPAN. Kiyonari, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). At. Jap.; 17: No. 5, Suppl., 44-54(May 1973).

Records and future programs of the national project for the development of fast breeder reactors, advanced thermal reactors and nuclear fuel are summarized. As for the FBRs, JOYO, a 100 MW(t) experimental reactor which will become critical in 1974, and MONJU, a 300 MW(e) prototype which is scheduled to be critical in 1978, are the main subjects of development. As for the advanced thermal reactor the construction of a 165 MW(e) prototype heavy water moderated boiling light water cooled reactor, FUGEN, is the main subject. It is scheduled to be critical in 1975. As for the development of nuclear fuel, the manufacture of fuel for the ATR and FBRs is summarized. The irradiation test of about 50,000 MWD/T has been completed, and some other irradiation tests are either underway or under planning. (JA)

5456 DEVELOPMENT OF THE FUEL HANDLING MACHINE FOR PROTOTYPE FAST BREEDER REACTOR MONJU. Suzuki, Y. Y. (Fuji Electric Co. Ltd., Kawasaki, Japan); Yanagisawa, T.; Hayakawa, S. Fuji Jiho; 46: No. 5, 477-481(May 1973). (In Japanese).

The in-core fuel exchange for the prototype fast breeder reactor "Monju" is intended to be performed by the fuel handling machine with pantograph mechanism. This fuel handling machine is mainly composed of a gripper, the pantograph mechanism, driving mechanism, casing, door valves and so on. In function test, every mechanism except the gripper and the pantograph mechanism was simulated corresponding to test conditions. The pantograph mechanism was subjected to atmospheric test and sodium loop test. Under the atmospheric test, the function test and eccentrical loading test were executed in the atmosphere at room temperature. (JA)

5457 APPLICATION OF MINIMAX PRINCIPLE TO DESIGN OF REACTOR IN-CORE MONITORING SYSTEM. Kobayashi, Y.; Okabe, K.; Kondo, S.; Togo, Y. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 12, 731-738(Dec 1973).

In the nuclear reactor core, particularly in that of the liquid metal cooled fast breeder reactor, it is required that local incidents be detected in their earliest possible phases. For this purpose, it is important to design an efficient in-core monitoring system. Systems that are too complicated, however, are liable to cause unwarranted diminution of plant availability. A means of selecting the optimum locations for the detectors, and opti-

mizing the sampling rates of the signals from a large number of in-core local detectors are described. These two approaches are studied as "decision under uncertainty" problems, using the minimax principle of the two-person zero-sum game theory, the idea being to minimize loss in the worst event. This involves an exhaustive search procedure in the former approach, and a linear programming technique in the latter. It is found that the methods used in this study are effective for designing an efficient in-core monitoring system, and that advantages worthy of note can be expected for them in practical applications, this despite the fact that the values of the parameters used in the numerical examples may not necessarily be representative of actual conditions. (auth)

5458 DEVELOPMENTAL RESEARCH IN SODIUM TECHNOLOGY FOR FAST BREEDER REACTORS. Ohno, M.; Tamaoki, T. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 29: No. 1, 52-57(Jan 1974). (In Japanese).

Participating in the national project directed by Power Reactor and Nuclear Fuel Development Corporation (PNC), Toshiba is devoted to the development of fast breeder reactors. In addition to a description of the works performed under the contracts with PNC, a report is given about a part of the developmental work on: components for the core, the cooling system, the waste disposal system; fission products in sodium; and sodium boiling. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 3095, 3371, 3424, 5356, 5385, 5455, 5515, 5516, 5529, 5530, 5578, 5623, and 5632.

5459 (ANL/EBR-78) EVALUATION OF GULF MODEL NLI-5B LOG N CHANNELS FOR USE IN EBR-II. Napper, D. H. (Argonne National Lab., Ill. (USA); Argonne National Lab., Idaho Falls, Idaho (USA)). Mar 1974. Contract W-31-109-eng-38. 48p. Dep. NTIS $5.50.

The log N, intermediate-range channels, are the last three of eleven nuclear channels for EBR-II to be upgraded from the vacuum-tube type of components to all-solid-state components. Because completely solid-state channels were not available with the operating information normal for nuclear channels, an extensive preinstallation test program was carried out to provide background information for use in subsequent in-plant operation and maintenance. For reactor safety, each channel must have sufficient trouble-free preinstallation operating time to essentially assure continuous operation in-plant. The channel was evaluated to verify performance, classify possible failure modes, and determine needed modifications. With the modifications, the channels meet all critical requirements for use in EBR-II. (auth)

5460 (EIR-246) RECONSTRUCTION OF THE REACTOR DIORIT I. Francioni, W. M.; Frick, U.; Riner, P.; Megaritis, G.; Conrad, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1973. 120p. (In German). Dep. NTIS (U. S. Sales Only) $9.00.

The DIORIT I reactor was disassembled after 10 years of operation and rebuilt with a new reactor vessel. The preparations made for the disassembly and criteria to be used in the removal, transport, and storage of the reactor components are outlined in detail. The disassembly itself is described fully. The preparations made for the rebuilding operation are discussed. The financial cost of the operation is given. The radiation monitoring carried out throughout the entire operation is discussed. (JSR)

5461 (EUR-5046) PULSED NEUTRONS AND THEIR UTILIZATION. Kley, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 73p. (CONF-721155-1). Dep. NTIS (US Sales Only) $6.75. EUR B.Fr. 100.-.

From 5th meeting on magnetism and neutron physics; Gaussig, German Democratic Republic (13 Nov 1972).

General considerations on the basic design elements of a periodically pulsed fast neutron source including core geometry, moderator geometry, and material composition as well as operational data, pulse frequency, pulse shape, and background problems are forwarded and their benefits discussed in detail. The design criteria for a high resolution time of flight spectrometers for coherent and incoherent elastic and inelastic scattering experiments are enumerated. (auth)

5462 (EURFNR-1164) INTERPRETATION OF SUBSTITUTION EXPERIMENTS PERFORMED IN THE FAST CRITICAL FACILITIES MASURCA AND SNEAK. Sotic, O. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Feb 1974. 58p. (KFK-1930). Dep. NTIS (U. S. Sales Only) $6.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Several substitution experiments performed in the fast critical assemblies MASURCA and SNEAK are analyzed by using the spectral-synthesis method. The method has been applied to solve the two region reactor problem, and the critical equation obtained is given in a suitable form, analogous to the one derived for thermal reactors. The dependence of radial buckling values on the size of the substituted region has been investigated. (auth)

5463 (FEI-371) WHAT DOES THE INTEGRAL EXPERIMENT IN PHYSICS OF FAST REACTORS PROVIDE (EXAMPLES OF THE ANALYSIS OF REACTOR-PHYSICS DATA ON A SIMPLE MODEL). Van'kov, A. A.; Voropaev, A. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 42p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.25.

The statistical analysis of integral reactor physics data is considered. The problem in the prediction of the characteristics of high-power reactors from experimental results and calculations for critical assemblies is formulated and solved. The data for the assemblies BFS-22 and BFS-23 are examined as a numerical example of the analysis (with inclusion of a simple calculation model for the reactor). (tr-auth)

5464 (FEI-403) EXPERIMENTAL AND CALCULATIONAL STUDY OF TWO FAST BFS CRITICAL ASSEMBLIES. Voropaev, A. I.; Dulin, V. A.; Kazanskii, Yu. A.; Mamontov, V. F.; Sidorov, G. I.; Lityaev, V. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 32p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.75.

The effect of the heterogeneity of the critical assemblies on some reactor functions (central reactivity coefficient, ratio of the mean cross sections, and neutron spectra and importance functions) was studied in the fast critical assemblies BFS-26 and BFS-27. Experimental data obtained in homogeneous and heterogeneous variants of the critical assemblies were compared with the corresponding calculated data. (tr-auth)

5465 (GEAP-10058) CONCEPTUAL DESIGN STUDY OF AXIAL FUEL COOLING HARDWARE FOR THE FFTF FUEL EXAMINATION FACILITY. Germer, J. H. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Development Operation). Jul 1969. 77p. Dep. NTIS $7.00.

A conceptual design study of an in-cell argon gas-cooling system and associated equipment for removal of decay heat from FFTF driver fuel assemblies during transfer, disassembly, and examination operations is reported. (JWR)

5466 (GKSS-73-E-25) TEMPERATURE TIME BEHAVIOUR IN THE MTR TYPE FUEL ELEMENTS OF THE FRG-2 AFTER SHUTDOWN OF THE PRIMARY PUMP. Krull, W.; Roebert, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Zentralabteilung Forschungsreaktoren). 1973. 4p. (In German). INIS.

In two core-configurations of the FRG-2 the temperature as a function of the time elapsed after shutdown of the primary pump was determined in the plates of the MTR-type fuel elements. The measurements were conducted at several power levels (1 to 15 MW). Particularly the temperature as a function of the time was investigated for emergency conditions: both of the convection flaps (8 to 15 MW), only one of the flaps open (8 to 15 MW), both of the flaps closed (1 to 1.5 MW). It is concluded, that in an emergency (failure of the primary pump and failure of one convection flap) no excessive temperature will occur. This conclusion is valid for the present maximal power level of 15 MW as well as for the power level of 21 MW applied for. (GE)

5467 (HEDL-SA-570) FAST FLUX TEST FACILITY. Nolan, J. E.; Morabito, J. J.; Simons, A. A.; Cockeram, D. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-2171. 25p. (CONF-740318-2). Dep. NTIS $4.25.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

A general plant description including the status of major component design and manufacture, present construction status, and progress toward program objectives is presented. The goals of the program are also discussed. (JWR)

5468 (HEDL-TME-72-50(Rev.1)) FFTF REACTOR PLANT TEST PLAN. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 34p. AT.

The plan for the construction testing and plant acceptance testing of the FFTF is described. Test categories and types, processing and approval sequences, and documentation requirements are defined. (JWR)

5469 (IFA-FR-96-1972) OBSERVATION OF A CLADDING FAILURE BY FISSION PRODUCT GASES FROM THE COOLANT. Vidrighin, R.; Ionescu, E.; Alexan, Z. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 6p. INIS.

Submitting to a radiochemical analysis the samples collected from the resulting gas mixture, one may draw some qualitative conclusions, which may be of interest for the life of the reactor; e.g., the existance of certain fission gases and their production in the reactor. Radiometric determinations were made by measuring the gamma energy spectra of the retained products. The gamma spectra were recorded by means of a multichannel analyzer with a NaI(Tl) scintillation detector. The spectrum is obtained especially for ^{133}Xe, ^{135}Xe, ^{85m}Kr and ^{87}Kr, at a WWR-C type reactor. In normal operating conditions of the reactor the occurrence of fission product gases in the degassing system may indicate, in their early stages, any failure or damage in the fuel element claddings. (INIS)

5470 (JAERI-1228, pp 195-197) ANALYSIS OF FCA-V-2 EXPERIMENTS USING THE JAERI FAST SET. Katsuragi, S. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. (In Japanese).

The results of an analysis made to confirm nuclear design features of the "JOYO" showed reasonable agreements with experiments and adequacies of design calculation methods, in general. In this comment, a few exceptional examples are presented in order to give an idea concerning limitations of calculation methods and inaccuracies of nuclear data. Directions for future activities of JAERI's data and methods group are also given. (auth)

5471 (JAERI-M-5371) REPORT ON THE OPERATION, UTILIZATION, AND TECHNICAL DEVELOPMENT OF RESEARCH REACTORS AND HOT LABORATORY. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 242p. (In Japanese). NTIS (US Sales Only).

The Division of Research Reactor Operation is engaged in the operation, maintenance, etc. of JRR-2, JRR-3, and JRR-4 (Japan Research Reactors), and of the Hot Laboratory for post-irradiation examinations of reactor fuels and materials. In the division, besides the operation and maintenance, other works are also performed, including the control of water and gas, radiation control, and irradiation. Further, research and development is performed on the technology of research reactors, facilities, etc. Research is in progress on the deposition of FPs, with the TLG-1 gas loop. In the Hot Laboratory, studies are performed on the post-irradiation examinations of various fuels and materials being developed. Studies performed in fiscal 1972 (April to March) and problems encountered and the procedures applied to solve them are described. (auth)

5472 (JAERI-M-5414) TRAINING OF OPERATORS AND MAINTENANCE PERSONNEL IN THE DIVISION OF RESEARCH REACTOR OPERATION AT JAERI. Takada, M.; Fukazawa, K.; Ishii, T.; Amano, H. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 11p. NTIS (US Sales Only).

In the division of Research Reactor Operation at JAERI, three kinds of training courses have been provided for operators and maintenance personnel of reactors. These are the courses for freshmen, for technicians, and for emergencies. The outline of these courses and also the procedures are described. (auth)

5473 (JAERI-M-5415) OPERATION AND MAINTENANCE EXPERIENCES WITH RESEARCH REACTORS, JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Takada, M.; Fukazawa, K.; Kohayakawa, T.; Ishii, T.; Morozumi, M. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 33p. NTIS (US Sales Only).

The four research reactors, JRR-1, JRR-2, JRR-3 and JRR-4, have been provided at Tokai Research Establishment, JAERI. JRR-1 ceased to operate in October 1968, due to superannuation of the reactor instruments and facilities. JRR-2 has been operated for about 13 years, JRR-3 for 11 years, and JRR-4 for 8 years. Maintenance has been performed on the reactors in order to keep them in a good operating condition, including pre-operational check, periodical inspection, and maintenance required by incidents. Several troubles on reactor instruments and facilities have been experienced, and their repairs and modifications have been performed. Some principal troubles, repair works, and modifications which have occurred and have been performed on JRR-2, JRR-3 and JRR-4, are described. Two large modification programs are now going on JRR-2 and JRR-3. It is expected that after completion of these programs, they should be operated more stably and be used more effectively. (auth)

5474 (JAERI-M-5416) IMPROVEMENTS OF REACTOR NEUTRON FLUX UTILIZATION. Takada, M.; Fukazawa, K.; Kohayakawa, T.; Ishii, T.; Morozumi, M. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 7p. NTIS (US Sales Only).

In order to make progress in research activities by utilizing research reactors, it was necessary to develop techniques which made it possible to use more intense neutron beams or to increase the experimental space in the high flux region. These were achieved by introducing some minor improvements of reactors and experimental facilities. Some of these achievements which have been performed on JAERI's research reactors are described. These are as follows: (1) Improvements of utilization technique in neutron spectroscopy; (2) Improvement of the fuel assembly as an in-core irradiation facility in JRR-2; (3) Improvements of neutron flux utilization in JRR-4; and (4) Deformation of neutron flux distribution to make it fit a proposed experiment. (auth)

5475 (KURRI-TR-109, pp 119-122) ON-LINE UTILIZATIONS OF A COMPUTER AT DCA. Shiba, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1973. (In Japanese).

In the experiments at "Deuterium-moderated Critical Assembly," data acquisitions and processings have been widely executed with the aid of the on-line system of a computer. Profiles of the software in this on-line system are mainly mentioned on utilizations in pulsed neutron experiments, measurements of coolant temperature coefficients of reactivity and countings of irradiated foils, respectively. (auth)

5476 (KURRI-TR-111) INVESTIGATION ON THE RADIOACTIVE ARGON GAS PRODUCED IN KYOTO UNIVERSITY REACTOR. Tsujimoto, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Oct 1972. 18p. (In Japanese). NTIS (US Sales Only).

Investigation was carried out on the radioactive argon gas produced in Kyoto University Reactor (KUR). Most of the radioactive argon gas is produced in the facilities of nuclear reactor. The radioactive argon gas produced in the facilities is released from a stack by two ways; it is exhausted from the stack through vent pipe connected to facilities, and from the stack via reactor room from the facilities. The volume of radioactive argon gas produced in the facilities was calculated and its radioactivity in the stack and reactor room was measured. (auth)

5477 (ORNL-TM-4553) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, OCTOBER–DECEMBER 1973. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 48p. Dep. NTIS $5.50.

The ORR operated at an average power level of 29.8 Mw for 86% of the time during October, November, and December of 1973. Twenty-three fuel elements were declared spent (47.9% average burnup) during the quarter, while 18 new elements were placed in service. Four shim-rod elements were retired from service at an average burnup of 78.6%. The reactor was shut down on 15 occasions, 14 of which were scheduled. Eight of the scheduled shutdowns terminated special low-power runs and end-of-cycle shutdowns accounted for 62.2% of the total downtime. Unscheduled downtime was only 4.5% of the total. The remaining downtime was used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements completed during the quarter included: (1) special test for proposed experiments, (2) core flux mapping, and (3) shim-rod calibrations. (auth)

5478 (RDT-F-1-1(12-73)) PREPARATION AND APPLICATION OF RDT STANDARDS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Dec 1973. 66p. RSO.

5479 SENSITIVITY OF A FAST CRITICAL ASSEMBLY TO UNCERTAINTIES IN INPUT DATA DETERMINED BY PERTURBATION THEORY. Hummel, H. H.; Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 1, 35-46(May 1974).

A study of the sensitivity of the integral properties of the plutonium-fueled fast-reactor critical assembly ZPR-6, Assembly 7 to uncertainties in the nuclear data has been performed with the aid of the VARI-1D variational sensitivity code; ENDF/B Version III was taken as a reference nuclear data base. The effect of 10% cross-section changes, which were correlated over the entire energy range, was analyzed, and allowed data uncertainties compatible with given uncertainties in integral parameters were established. Estimated uncertainties in important cross sections were considered, and the effect of different assumptions of the correlation in energy of the data uncertainties was examined. The effect of data changes among ENDF/B Versions I, II, and III was also analyzed. The most important data uncertainties are in the fission cross section of ^{239}Pu and in the capture cross section of ^{238}U, while the most important uncertainties in integral properties are in sodium void effect, breeding ratio, and k_{eff}. (auth)

5480 MEASUREMENT OF THE SPECTRAL PARAMETERS OF THE THERMAL NEUTRON FIELD IN THE VVR AND MR REACTORS. Lomakin, S. S.; Panfilov, G. G.; Petrov, V. I.; Rogozhkin, I. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 9-10(1972). (In Russian).

The results of the integral method measurement of the effective temperature of thermal neutrons in the active zone of the MR and VVR reactors using Lu, Cu, and Mn detectors were reported. The results obtained agree satisfactorily with the measurements carried out in reactors similar in parameters by the measurement of the reactivity and from the activation ratio of ^{239}Pu and ^{235}U. (tr-auth)

5481 FRJ-1 (JUELICH) AFTER POWER ENHANCEMENT TO 10 MW. Bormann, H. J. (Kernforschungsanlage, Juelich, Ger.); Kalker, K. J.; Katscher, W.; Muench, E. Atomkernenergie; 23: No. 1, 39-43(1974). (In German).

Parameters and results of reactor physics measurements with regard to the 10 MW operation of the FRJ-1 reactor are given. The necessary changes in reactor components made in order to increase the power from 5 to 10 MW are described; the critical core configuration, coolant and neutron flux density distributions, absorber properties and temperature values for the core and the coolant loops are reported. (GE)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 2470, 3050, and 5634.

5482 ALTERNATIVES FOR ENERGY GENERATION AND DISTRIBUTION. Latzko, D. G. H. Ingenieur (Utrecht); 85: No. 28-29, 604-614(12 Jul 1973). (In Dutch).

The arguments for and against various "environmentally acceptable" generation and distribution techniques are summarized, including solar power, fuel cells and a hydrogen economy (using nuclear power to produce a "clean" fuel—hydrogen—by electrolysis of seawater). How some of these techniques might be realistically phased in, and certain environmentally objectionable conventional techniques phased out, by the beginning of the next century is discussed. (NL)

5483 WHY NOT NUCLEAR-BASED DISTRICT HEATING. Margen, P. H. (Aktiebolaget Atomenergie, Stockholm). Tek. Tidskr.; 103: No. 18, 37-39(9 Nov 1973). (In Swedish).

The author criticizes the economics contained in an article by Carl-Erik Lind ("Thermal Power Stations or Nuclear Power?" Teknisk Tidskrift, 1973, No. 15, pp. 28, 32) and suggests the development of nuclear power and district-heating stations. New techniques would be necessary: the turbines would be driven partly as condensing sets and partly as back-pressure sets. The areas in Sweden of interest for such a development would be the most highly populated parts of the country, i.e., greater Stockholm, greater Gothenburg and southwest Skane (Scania). (SW)

5484 NUCLEAR SITING AND WELFARE PROBLEMS. Envisioning a New System of Siting Technology. Takahashi, M. (Central Research Inst. of Electric Power Industry, Tokyo). At. Jap.; 17: No. 5, Suppl., 101-105(May 1973).

The technology is proposed for converting a big waste heat system into a big productive eco-system by utilizing controlled enclosure, to the benefit and welfare of the people around an energy center. In this way, the problems of thermal pollution can be diminished by the use of a completely controlled and properly arranged "entropy cascade system" composed of various eco-systems with gradually decreasing optimum temperatures. The people around an energy center have many opportunities to be benefited by various welfare systems, including agricultural production in the land improved by heating. (JA)

5485 FAST NEUTRON SPECTRA IN STANDARD SEED IRRADIATION FACILITIES FOR TRIGA REACTORS. Krajnik, J.; Najzer, M.; Pauko, M.; Rant, J. (Univ. of Ljubljana, Yugoslavia). pp 21-29 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Neuberberg, F. R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Two facilities have been tested at TRIGA Mark II reactor in Ljubljana, one located in the reactor pool and the other in the thermal column. The outstanding characteristic of such facilities is their relatively high fast neutron to gamma dose ratio. They are made of depleted uranium acting as a converter of thermal to fast neutrons and simultaneously as an excellent gamma and thermal neutron shield. The user is principally interested in fast neutron and gamma dose rates and fast neutron spectra in the facilities. Dose rates had been previously determined by ionization chambers. The measurement of the fast neutron spectra is described. A set of nine threshold detectors, $^{103}Rh(n,n')$, $^{115}In(n,n')$, $^{64}Zn(n,p)$, $^{32}S(n,p)^{32}P$, $^{27}Al(n,p)$, $^{56}Fe(n,p)$, $^{24}Mg(n,p)$, $^{27}Al(n,\alpha)$, $^{19}F(n,2n)$, was used. The effective thresholds of the above set range from 0.7 to 12 MeV. Induced activities were detected by a calibrated NaI(Tl) scintillation spectrometer. Activation data were unfolded by the code ITER to obtain fast neutron spectra. Different input approximations were studied to obtain a reasonable estimate of uncertainties in the energy region below 1.5 MeV, which is the region most sensitive to experimental errors. The spectra were converted to fast neutron dose rates and the results compared with dose rates obtained with ionization chambers. (auth)

5486 RESONANCE ENERGY NEUTRON BEAMS FROM REACTORS FOR RADIOBIOLOGY STUDIES. Bryant, K. R.; Bull, S. R. (Univ. of Missouri, Columbia). pp 31-48 of Biological Effects of Neutron Irradiation. Vienna; International Atomic Energy Agency (1974).

From effects of neutron irradiation upon cell function; Neuberberg, F. R. Germany (22 Oct 1973). See STI/PUB-352; CONF-731038-.

Radiobiology investigations with neutrons are typically concerned with thermal or fast neutrons as the radiation source. Neutrons of these energies are readily available from nuclear reactors or charged particle accelerators, while the resonance energy neutron regime offers a greater challenge for production of a useful beam of neutrons. A study was undertaken to design a neutron beam filter system to produce a resonance energy neutron beam from the moderated fission spectrum of a research reactor, to examine the utility of a resonance beam for radiobiology studies, and to determine the implications of the dosimetry predictions. Select elements such as iron, scandium and silicon have neutron cross-sections that exhibit a pronounced dip (or window) at an energy in the resonance region. If proper combinations of materials are used in a filter design, a reactor neutron spectrum will be filtered and only neutrons at the window energy will be transmitted. The window energies for iron, scandium and silicon are 24, 2 and 144-keV, respectively. A combination of iron and aluminium was used to design a filter that gave a quasi-monoenergetic neutron beam at 24 keV. The neutron spectra were calculated with a one-dimensional neutron transport code. A filter consisting of 110 cm of iron and 10 cm of aluminium produced a beam with a signal-to-noise ratio of 60, which is consistent with existing experimental results. A resonance energy neutron beam is useful for numerous radiobiology studies; one related application considered was the imaging of biological specimens. Computations were made to evaluate the quality of radiographs made with the 24-keV beam. The image contrast was good for the various combinations of air, tissue, fat and muscle considered. In particular, the contrast between lung and carcinoma was better with neutrons than with X-rays. While the neutron beam is relatively monoenergetic, the total dose contributed by neutrons of all other energies was significant. Such an approach, however, can provide a neutron source in an energy range that has received relatively little attention. (auth)

5487 VVR-S NUCLEAR REACTOR AS A SOURCE OF NEUTRONS. Pittermann, J. (Ceskoslovenska Komise pro Atomovou Energii, Rez). Radioisotropy; 14: No. 3, 404-413(1973). (In Czech).

The irradiation facilities of the VVR-S reactor, the sole intense neutron source in Czechoslovakia, are described. The measured flux density values of thermal, epithermal, and fast neutrons in the individual irradiation channels of the reactor are reported. These values form the basis for considerations on the form of the neutron spectra in the individual energy regions. Attention is paid also to questions of the irradiation itself and of the customer's requirements on the reactor irradiation service. The problems of possible heat generation in the irradiated sample, effect of the active zone configuration on the neutron flux density distribution, changes of the neutron flux density due to changes of the neutron flux density gradient, exposure rate monitoring, sample geometry etc. are discussed. Finally, information on irradiation conditions and their control and on prices for irradiation works are given. (auth)

5488 NUCLEAR STEELMAKING PROJECT. At. Jap.; 7: No. 7, 12-21(Jul 1973).

The Agency of Industrial Science and Technology (Ministry of International Trade and Industry) has decided to launch a large-scale project on the research and development of iron making by nuclear energy, starting in July 1973. It is because of energy problem and environmental conservation. The long-range program consists of a pilot plant connected to an experimental HTGR in the first stage, an industrialization test plant to make for a prototype reactor in the second stage, and a commercial plant in the third stage. The first phase in the first

stage, six of 11 years, is described. Heat exchangers, super heat-resistant alloys, high-temperature insulation materials, reducing-gas producing units, direct reduction equipments, and total system should be studied and developed. (JA)

Propulsion and Package Reactors

Refer also to abstract 3775.

5489 (AD-764231) THERMAL AND REACTOR ANALYSIS OF NUCLEAR ROCKET TRANSIENTS. Mills, R. R. Jr. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Mar 1973. 215p. (EERL-MP-E-73-2). NTIS $5.50.

Thesis.

The thermal and nucleonic behavior of a nuclear rocket during the startup transient was investigated. The fluid flow and heat transfer of the hydrogen coolant was thoroughly analyzed. It was found that the ideal gas law produced reasonably accurate results over the range of temperatures and pressures used. A one-dimensional time-independent form of the three-dimensional time-dependent fluid flow equations was developed and shown to be suitable for calculations over a very wide range of fluid temperature and pressure. An expression for heat transfer in the fuel-moderator was derived which simplified time-dependent calculations of average fuel temperature distributions and wall temperature distributions. A three-group model of the reactor physics provided a good understanding of the neutronics of a NERVA reactor. (auth)

5490 (CNLM-6155) FUELS AND MATERIALS HIGHLIGHTS: SNAP-50 AND ADVANCED PROGRAMS. Raring, L. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 18 Feb 1965. Contract AT(30-1)-2789. 32p. Dep. NTIS $3.75.

Declassified 17 Sep 1973.

Highlights of the fuels, structural materials, alkali metal coolant, etc., development programs include: irradiation, compatibility, and physical properties of UC and UN; development of Nb–1 Zr–0.1 C (PWC-11) and other materials; coatings; and corrosion by alkali metals. (DLC)

5491 (CONF-730942-P4, pp vp Paper J 2/9) SAFETY CONTAINMENT FOR NUCLEAR POWERED SHIPS. Lettnin, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H, Geesthacht, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The safety containment of a nuclear power plant has to prevent the release of radioactive material in the environment in case of any credible accident. It has to maintain its integrity under all possible accident conditions, such as pressure and temperature build-up, explosions and damaged mechanical parts acting as missiles. In addition to these loadings, the safety enclosure on board of a nuclear powered vessel has to withstand additional stresses. The ship and its internal components are exposed to additional accelerations induced by sea motions. A special problem is vibrations excited by sea motions, ship propeller or auxiliaries. While the frequency of roll, pitch and heave is below one cps and therefore usually of no concern for the nuclear plant, ship propeller excitations have to be analyzed very carefully to avoid resonances of reactor components. The usual solution for the safety enclosure is the dry containment (i.e., a pressure shell which withstands the highest possible pressure in case of a LOCA). This type of containment is used for the nuclear powered ships "Savannah", "Otto Hahn" and "Mutsu". A more advanced design is the wet containment using a pressure suppression system for the pressure restriction in the enclosure. Due to the low pressure, the safety enclosure can be fully integrated into the ship's structure using longitudinal and transverse bulkheads as parts of the containment. The different construction principles are discussed, using as examples the N. S. "Otto Hahn" and the study for an 80,000 shp nuclear propelled container ship. 11 references. (auth)

5492 (CONF-730942-P4, pp vp Paper J 3/7) IMPACT TESTING OF CONTAINMENT VESSELS OF MOBILE REACTOR SYSTEMS. Holton, R. L. (Air Force Weapons Lab., Kirtland AFB, NM). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A major technological problem associated with the operational feasibility of a nuclear powered aircraft and other mobile reactor systems involves the potential hazards associated with the spread of radioactive fission products from the reactor in the event of an accident. The current test series at the Air Force Special Weapons Center's high-speed sled track at Holloman AFB is an outgrowth of recent studies that have been performed to analyze various potential reactor hazards, e.g., loss of coolant, loss of coolant flow, and core compaction. These studies demonstrated the need for intensive evaluation of selected reactor containment vessel configurations. The overall objective of the testing is to develop data to demonstrate the feasibility of containing nuclear fission products at impact velocities of 800 to 1000 ft/sec. To achieve this objective, investigations are being made to determine the impact response characteristics of simulated nuclear containment vessels under controlled conditions. (auth)

5493 (CONF-730979-, pp 279-287) NEW ASPECTS OF INTERNATIONAL MARITIME LAW: PROVISIONS FOR NUCLEAR SHIPPING. de los Santos, A. (Junta de Energia Nuclear, Madrid). Nov 1973. (In Spanish).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The opposition created by nuclear vessels before the maritime law governing nuclear shipping is briefly summarized. The studies made leading to the present law and its provisions are described. (JSR)

5494 (CONF-730979-, pp 289-294) NUCLEAR SHIPPING IN YUGOSLAV MARITIME LAW. Filipovic, V. (Univ. of Zagreb). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The special provisions of the Yugoslav maritime law to regulate nuclear shipping and its compliance with international conventions are discussed. (JSR)

5495 (CONF-730979-, pp 295-304) EXPERIENCE WITH THE N.S. "OTTO HAHN". Ulken, D. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The experiences gained in the operation of the Otto Hahn are briefly summarized. The safety precautions taken and recent improvements to the vessel are indicated. (JSR)

5496 (CONF-730979-, pp 305-310) CONSIDERATIONS OF THE FUTURE APPLICATION OF THE LAW OF NUCLEAR SHIPS. Boulanger, W. (Bundesministerium fuer Forschung und Technologie, Bonn). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The future application and development of laws on nuclear vessels are outlined. Present questions frequently occurring in the operation of nuclear vessels are discussed. The future application of the present law is considered. (JSR)

5497 (GEMP-600(Vol.4)) 710 HIGH-TEMPERATURE GAS REACTOR PROGRAM SUMMARY REPORT. Volume IV. Critical Experiment and Reactor Physics Development. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1968. Contract AT(40-1)-2847. 94p. Dep. NTIS $7.75.

Declassified 6 Sep 1973.

This volume of the 710 Reactor Program Summary Report contains a summary of the critical experiment and reactor physics development work performed under the 710 High-Temperature Gas Reactor Program. (auth)

5498 (GEMP-600(Vol.5)) 710 HIGH-TEMPERATURE GAS REACTOR PROGRAM SUMMARY REPORT. Volume V. Fuel Element Stress Analysis. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1967. Contract AT(40-1)-2847. 59p. Dep. NTIS $6.00.

Declassified 6 Sep 1973.

This volume of the 710 High-Temperature Gas Reactor Program Summary report contains a summary of the stress/strain considerations and analyses involved in the evaluation of the structural adequacy of the 710 fuel element. (auth)

5499 (N-73-22724) NUCLEAR ELECTRIC PROPULSION MISSION ENGINEERING STUDY. Volume 1. Executive Summary. Final Report. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Mar 1973. 24p. (NASA-CR-131599). NTIS $3.25.

For Jet Propulsion Lab., Pasadena, CA.

Results of a mission engineering analysis of nuclear-thermionic electric propulsion spacecraft for unmanned interplanetary and geocentric missions are summarized. Critical technologies associated with the development of nuclear electric propulsion (NEP) are assessed. Outer planet and comet rendezvous mission analysis, NEP stage design for geocentric and interplanetary missions, NEP system development cost and unit costs, and technology requirements for NEP stage development are studied. The NEP stage de-

sign provides both inherent reliability and high payload mass capability. The NEP stage and payload integration was found to be compatible with the space shuttle. (auth) (STAR)

5500 (N-73-22725) NUCLEAR ELECTRIC PROPULSION MISSION ENGINEERING STUDY. Volume 2. Final Report. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Mar 1973. Contract NAS7-100. 263p. (NASA-CR-131600). NTIS $15.25.

For Jet Propulsion Lab., Pasadena, CA.

Results of a mission engineering analysis of nuclear-thermionic electric propulsion spacecraft for unmanned interplanetary and geocentric missions are summarized. Critical technologies associated with the development of nuclear electric propulsion (NEP) are assessed, along with the impact of its availability on future space programs. Outer planet and comet rendezvous mission analysis, NEP stage design for geocentric and interplanetary missions, NEP system development cost and unit costs, and technology requirements for NEP stage development are studied. (auth) (STAR)

5501 (N-74-12364) EFFECT OF REACTOR COOLANT RADIOACTIVITY UPON CONFIGURATION FEASIBILITY FOR A NUCLEAR ELECTRIC PROPULSION VEHICLE. Soffer, L.; Wright, G. N. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Dec 1973. 10p. (NASA-TM-X-2949). NTIS $2.75.

A preliminary shielding analysis was carried out for a conceptual nuclear electric propulsion vehicle designed to transport payloads from low earth orbit to synchronous orbit. The vehicle employed a thermionic nuclear reactor operating at 1575 kilowatts and generated 120 kilowatts of electricity for a round-trip mission time of 2000 hours. Propulsion was via axially directed ion engines employing 3300 pounds of mercury as a propellant. The vehicle configuration permitted a reactor shadow shield geometry using LiH and the mercury propellant for shielding. However, much of the radioactive NaK reactor coolant was unshielded and in close proximity to the power conditioning electronics. An estimate of the radioactivity of the NaK coolant was made and its unshielded dose rate to the power conditioning equipment calculated. It was found that the activated NaK contributed about three-fourths of the gamma dose constraint. The NaK dose was considered a sufficiently high fraction of the allowable gamma dose to necessitate modifications in configuration. (auth)

5502 (N-74-14366) ADVANCED-POWER-REACTOR DESIGN CONCEPTS AND PERFORMANCE CHARACTERISTICS. Davison, H. W.; Kirchgessner, T. A.; Springborn, R. H.; Yacobucci, H. G. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jan 1974. 22p. (NASA-TM-X-2957; E-7614). NTIS $2.75.

Five reactor cooling concepts which allow continued reactor operation following a single rupture of the coolant system are presented for application with the APR. These concepts incorporate convective cooling, double containment, or heat pipes to ensure operation after a coolant line rupture. Based on an evaluation of several control system concepts, a molybdenum clad, beryllium oxide sliding reflector located outside the pressure vessel is recommended. (auth) (STAR)

5503 LITHIUM HYDRIDE: A SPACE AGE SHIELDING MATERIAL. Welch, F. H. (Atomics International, Canoga Park, CA). Nucl. Eng. Des.; 26: No. 3, 444-460(1974).

Lithium hydride (LiH) is a useful, lightweight, neutron-shielding material for mobile nuclear reactors, such as the one considered for the Space Reactor Program. The fabrication of LiH bodies is traced from early pressing and casting operations through over a decade of casting development work to the current casting capability existing at the Nuclear Field Laboratory of Atomics International. The capability of the newest LiH shield casting facility, and what is believed to be the world's largest LiH neutron shield are discussed in detail. Basic characteristics of a number of LiH neutron shields are also tabulated. 21 references. (auth)

5504 ACCURACY PROBLEMS IN THE POINT KINETICS OF THE OTTO-HAHN REACTOR. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). (1974). vp. (In German).

From experts meeting of the task groups Thermodynamics and Fluid Dynamics and Reactor Physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, Germany (29 Jan 1974).

In the Otto Hahn Reactor core more steam bubbles are present than in PWR type reactors. Besides the larger reactivity coefficients, there exists a negative pressure coefficient and the reactor remains stable without an automatic control system. Yet the existence of bubbles means that the prediction of the reactivity coefficients is more complicated. Therefore, an experimental measuring program and additional computer programs were established in order to get information about the obtainable prediction accuracy. (GE)

5505 DYNAMICS MEASUREMENTS DURING THE START-UP EXPERIMENTS OF THE OTTO-HAHN REACTOR WITH ITS SECOND CORE. David, B.; Kolb, M.; Robinson, E.; Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau and Schiffahrt mbH, Geesthacht, Ger.). (1974). vp. (In German).

From experts meeting of the task groups Thermodynamics and Fluid Dynamics and Reactor Physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, Germany (29 Jan 1974).

During the start-up experiments, measurements of self-regulating behavior and isothermal temperature coefficient, as well as pseudostochastic experiments were carried out. The test conditions, which are influenced by the actual Xenon poisoning, and the reactivity worths of the rods at power were studied in particular. (GE)

5506 CONTAINER SHIPS: OIL FUELED VERSUS NUCLEAR POWERED. Dade, T. B.; Witzig, W. F. (Pennsylvania State Univ., University Park). Nucl. Technol.; 22: No. 2, 196-223 (May 1974).

Innovations in the maritime industry to increase ship productivity, along with the sharp rise anticipated for the cost of fossil fuel, call for a reappraisal of marine nuclear propulsion to meet the high power requirements of modern container ships. A recently designed oil-fueled, high-speed, quick-turnaround container ship was used as the base for a comparison to assess the economic feasibility of nuclear propulsion for ships of this type. To avoid inadvertent advantage to one or the other alternative, both were analyzed according to two independent economic criteria: (a) average annual operating costs, and (b) average annual net profit. Each of these criteria accounts for the significant costs incurred by the ship over its life, including the effects of taxes and the time value of money. The results of sensitivity computations indicate that the nuclear-powered container ship, as modified for this comparison, would now be competitive with the oil-fueled ship on transatlantic routes. A similar ship specifically designed for nuclear propulsion should have an economic advantage. 23 references. (auth)

5507 SATELLITE NUCLEAR POWER STATION: AN ENGINEERING ANALYSIS. Williams, J. R.; Clement, J. D.; Rosa, R. J.; Kirby, K. D.; Yang, Y. Y. Atlanta; Georgia Institute of Technology (1973). 143p.

A nuclear-MHD power plant system which uses a compact non-breeder reactor to produce power in the multimegawatt range is analyzed. It is shown that, operated in synchronous orbit, the plant would transmit power safely to the ground by a microwave beam. Fuel reprocessing would take place in space, and no radioactive material would be returned to earth. Even the effect of a disastrous accident would have negligible effect on earth. A hydrogen moderated gas core reactor, or a colloid-core, or NERVA type reactor could also be used. The system is shown to approach closely the ideal of economical power without pollution. (IAA)

5508 REACTOR POWER PLANT FOR UNDERSEA APPLICATIONS. Brasier, R. I.; Mills, C. B. (Los Alamos Scientific Lab., NM). Contract W-7405-Eng-36. Nucl. Technol.; 22: No. 2, 224-228(May 1974).

A pressurized water reactor suitable for unattended operation on the ocean floor has been designed. Its inherent safety, simplicity, and low cost also make it attractive for many applications on land. The conceptual design, which is patented, is based on the principle of minimum critical mass, such that any change in materials, size, shape, or fuel density results in a less reactive condition and, if the change is sufficiently large, results in automatic shutdown. 5 references. (auth)

5509 COMPACT REACTOR POWER SYSTEMS. Brunings, J. E.; Mason, D. G.; Thomson, W. B.; Van Osdol, J. H. (Atomics International, Canoga Park, CA). Nucl. Technol.; 22: No. 2, 237-251(May 1974).

The SNAP zirconium hydride reactor developed by the U. S. Atomic Energy Commission for space applications can also be used for the generation of power in marine applications. This reactor can be coupled with thermoelectric, organic Rankine, Brayton, and supercritical CO_2 power conversion systems to yield compact, long-life power systems in the power range from several kW(e) to over 150 kW(e). The thermoelectric power conversion system, although exhibiting cycle efficiencies in the 7 to 10% range, has proven long-life capability. The Brayton and the supercritical CO_2 systems yield the smallest power systems, while the

Brayton system yields the lightest system. The low operating temperatures and the relatively high efficiency of the organic Rankine system imply that this system exhibits the lowest unit cost. (3 references) (auth)

5510 TRANSIENT ANALYSIS OF HEAT PIPES WITH APPLICATIONS TO SELECTED EXPERIMENTS AND A CONCEPTUAL REACTOR DESIGN. Bowers, C. H. Columbus, OH; Ohio State Univ. (1973). 269p. University Microfilms Order No. 74-3124.

Thesis (Ph. D.).

Liquid metal heat pipes provide a simple and reliable means to transport the large quantities of energy at high temperatures that would be produced by the reactor of any space nuclear power plant. A computerized model of two dimensional transient heat pipe vapor flow with a one dimensional wick analysis is presented. This analysis could be used as the basis for a more complete design code to predict the response of the heat pipes to reactor power transients for any proposed design. The two dimensional vapor flow calculation is based on the Implicit Continuous Fluid Eulerian, ICE, Method developed at Los Alamos Scientific Laboratory and the one dimensional wick analysis is based on experimental correlations obtained from the literature. The result is a code which predicts the response of a heat pipe to various transient power loads. Comparisons with analytical and experimental results are offered and a proposed concept is analyzed highlighting the advantages of the use of such a code in any proposed design. (Diss. Abstr. Int., B)

5511 WHATEVER HAPPENED TO NUCLEAR POWER? Surveyor (N.Y.); 6: No. 4, 2-9(Nov 1972).

Though the nuclear ship Savannah was retired for unprofitability, ship operators are taking another look at nuclear power. Rising fuel costs and the demand for higher speed are now making power economically competitive. A basic marine nuclear plant is illustrated. Future plans of the Babcock & Wilcox (B&W) Company, which developed a 2nd generation system, the consolidated nuclear steam generator, are described. General Electric will be called upon to furnish the turbine propulsion unit for the B&W plant. (Oceanic Abstr.)

5512 NUCLEAR ENERGY SOURCES FOR MARINE OIL PROSPECTING. Devin, B. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Fr. Energ.; 25: No. 257, 59-61(Oct 1973). (In French).

A brief description is given of two types of nuclear energy source developed for oil prospecting in the sea: nuclear reactors having large power outputs used either for propulsion (1 to 80 MW) e.g., those equipping French nuclear submarines, or, as marine power sources (providing up to 100 MW) operating without anchoring with submersion equipment for in-shore and off-shore (deep sea) prospecting; thermoelectric reactors providing mean powers of between 10 KW and 1 MW capable of being submerged to any depth and of operating without connections with the surface for several years without maintenance. (FR)

5513 NUCLEAR MARITIME: AN ECONOMIC REVIVAL. Dickinson, R. W.; Esleeck, S. H.; Lemon, J. E. Genshiryokusen; No. 114, 2753-2774(Apr 1973). (In Japanese).

The recent situation of shipping industry, namely high powered ships of large size and high speed, rise in petroleum price and drop in nuclear fuel price, points to the large possibility in future of nuclear powered ships taking the place of conventional ones. The following are described: world situation of shipping circles; significance of nuclear powered ships; the current state of nuclear ship propulsion; CNSG in West Germany; cost in the navigation of nuclear-ships; and economy of nuclear powered ships. (JA)

Reactor Safety and Environmental Aspects

Refer also to abstracts 3142, 3146, 3151, 3166, 3175, 3179, 3196–3198, 5339–5341, 5352, 5354, 5361, 5367, 5369, 5385, 5386, 5466, 5484, 5654, and 5665.

5514 (AEC-tr-7539) SCIENTIFIC REPORTS: SITING OF NUCLEAR TECHNICAL INSTALLATIONS TO PREVENT EXTERNAL INFLUENCES. Aircraft Impact Intermediate Report. Drittler, K.; Gruner, P.; Suetterlin, L. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Dec 1973. Translation of IRS-W-7. 24p. Dep. NTIS $4.25.

Load assumptions are presented which, form the basis for designing nuclear power plants against the consequences which might arise from aircraft impact on reactor buildings. The local effects of impact and the effects on the construction as a whole are examined. Penetration formulas are offered which allow for the calculation of the minimum thickness of the protective walls. A load-time-function for the impact of aircraft on rigid walls is presented. Suggestions for future guidelines are given. (auth)

5515 (ANL-7638) VARIABLE TEMPERATURE RODDED ZONE PROJECT FINAL SAFETY ANALYSIS REPORT. Lewis, R. A.; Dance, K. D.; Meyer, J. F.; Bohn, E. M. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-100-eng-38. 166p. AT.

This document contains information relating Variable Temperature Rodded Zone (VTRZ) safety considerations, safety systems, and safety analyses to proposed VTRZ operations. Additionally it addresses questions related to facility management and operation, operating rules, and operating procedures. The document is legalistic in the sense that it is approved by the AEC and contains implicit commitments governing VTRZ operations. (auth)

5516 (ANL-8071) COMPARISON OF FFTF SIMPLE-MODEL TESTS WITH REXCO PREDICTIONS. Nagumo, G.; Fiala, C. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-eng-38. 58p. AT.

The predictions of a two-dimensional reactor-containment code (REXCO-HEP) are compared with experiments designed to simulate hypothetical core-disruptive accidents in simple vessel models of a Fast Flux Test Facility. The energy source used in these experiments is shock free and is characterized for application in computer codes. The simulations by the code include six tests of simple models stressed at energy equivalents of 150 and 350 MW-sec at $1/_{30}$th and $1/_{10}$th scale. Comparisons of calculated and measured data validate the capability of REXCO-HEP to predict the response of small-scale models and to provide insight for the evaluation of experimental data. The experiments of the simple models were conducted by the Stanford Research Institute, Menlo Park, California, for the Hanford Engineering Development Laboratory, Richland, Washington. (auth)

5517 (CEA-CONF-2531) FIRE PREVENTION IN NUCLEAR POWER PLANTS. Chappellier, A. (CEA, 75-Paris (France)). 1973. 26p. (In French). (CONF-731068-1). Dep. NTIS (U. S. Sales Only) $3.50.

From 4th international seminary on fire prevention; Zurich, Switzerland (18 Oct 1973).

The French philosophy on the safety of nuclear reactors is summarized and the importance of the risk of fire in the analysis of this safety is shown. The possible causes of fire in nuclear power plants are outlined and typical cases are described. The consequences of fires are discussed. Particular consequences characteristic of a specific reactor type are briefly indicated. Constructive precautions for the prevention of fire are discussed. The automatic alarm and control system necessary are described. (JSR)

5518 (CEA-CONF-2572) PROGRAMS FOR THE ELASTO-PLASTIC CALCULATION OF STRUCTURES. Goldstein, S.; Hoffmann, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1973. 29p. (In French). (CONF-730998-1). Dep. NTIS (U. S. Sales Only) $4.50.

From French congress of mechanics conference; Poitiers, France (17 Sep 1973).

The system of codes developed by the CEA at Saclay for the elastoplastic calculation of high temperature reactors, light water cooled reactors, and fast neutron reactors is presented. Two codes based on the finite element method are given: the bidimensional PASTEL and the tridimensional structural shell TRICO. The principal characteristics of these codes are described. The iterative method for plasticity in PASTEL and the plasticity model for the structural shells used in TRICO are given. Some examples of the application of these codes are reported. (JSR)

5519 (CONF-730942-P4, pp vp Paper K 1/1) USE OF SEISMOTECTONIC AND TECTONIC PARAMETERS FOR DETERMINATION OF A DESIGN BASIS EARTHQUAKE. Schneider, G. (Univ., Stuttgart). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Since earthquakes are not pointlike sources of elastic waves distributed in a statistical manner over the area under study but shear-like fracture processes concentrated to active zones of small lateral extension, one should consider also the seismological experience about the seismic focal process when one tries to determine a design basis earthquake. As one of the most helpful parameters to describe the seismic focal mechanism one can regard the tectonic efficiency of the focal T_0 ($T_0 = F_0 \cdot d_0$ = fracture surface extension · average dislocation on the fracture surface). The tectonic efficiency is closely related to the earthquake magnitude M, used as logarithmic energy

value for studies of seismicity and earthquake statistics. The "statistical" M_{max} can now be controlled by determination of the maximum size of a seismically active fault-system. Besides seismic parameters also tectonic field observations and repeated geodetic measurements executed to measure fault-extensions and dislocations during recent time and young geologic past can be used as additional information to predict an earthquake with maximum thinkable T_0. The aim of future work must be to locate the faults inside the area showing the highest probability to produce a certain maximum-T_0 earthquake. Seismic foci as extended sources of elastic waves are characterized by very typical radiation patterns being very stable during the observation intervals covered until now. The combined study of fault-plane solutions and recent/young movements on faults will give us a more reliable picture of the probable seismotectonic future of a certain area and also of a definite site. Examples are taken from central and southern Europe. 22 references. (auth)

5520 (CONF-730942-P4, pp vp Paper K 1/2) GEOPHYSICAL FUNDAMENTALS FOR THE DEVELOPMENT OF SEISMIC TIME HISTORIES ON A STATISTICAL BASIS. Schneider, G. (Univ., Stuttgart). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Every seismic time function (seismogram) recorded somewhere on the Earth's surface contains principally three groups of information: (a) the seismic source function, (b) the transfer function of the medium through which the seismic waves are travelling between the focus and the underground of the instrument, (c) the transfer function of the seismograph system. The source function is controlled by focal parameters as the tectonic efficiency and the seismic fracture velocity $v_{f0}(t)$. Overtaking the limiting estimated measures of T_0 from the seismotectonic studies we have the possibility to produce a certain number of probable artificial source-time functions by statistical variation of the v_{f0} time history. These records can be compared with near-focus seismograms recorded on crystalline basement where the latter can be regarded as first possible approximations of real near-source records. A number of pulse forms and their according spectra which can be used as input for the propagation medium are derived. 12 references. (auth)

5521 (CONF-730942-P4, pp vp Paper K 1/5) DEVELOPMENT OF REAL/SYNTHETIC TIME HISTORIES TO MATCH SMOOTH DESIGN SPECTRA. Rizzo, P. C.; Shaw, D. E.; Jarecki, S. J. (E. D'Appolonia Consulting Engineers, Inc., Pittsburgh). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In modern nuclear plant design, there is a definite trend toward time history type analysis of equipment and structural components to determine the peak seismic response and loads. However, the site response spectra remain as the only acceptable description of expected ground motion during a seismic event. Thus, it has become necessary to develop time history accelerograms compatible with smoothed response design spectra established for a site. A new computerized technique for generating time history accelerogram traces from existing seismic records to match the smoothed site response spectra is described. (auth)

5522 (CONF-730942-P4, pp vp Paper K 2/1) REVIEW OF SOIL-STRUCTURE INTERACTION EFFECTS IN THE SEISMIC ANALYSIS OF NUCLEAR POWER PLANTS. Scavuzzo, R. J. (Rensselaer Polytechnic Inst. of Connecticut, Inc., Hartford); Raftopoulos, D. D. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A survey of recent investigations of soil-structure interaction in seismic analysis of nuclear power plants is presented. This survey is divided into two major sections: analytical methods and results of investigations. After a brief outline of solutions based on spring mass models, half space models and finite element procedures, results of various investigators are presented and in some cases compared. 47 references. (auth)

5523 (CONF-730942-P4, pp vp Paper K 2/4) FINITE ELEMENT TREATMENT OF SOIL-STRUCTURE INTERACTION PROBLEM FOR NUCLEAR POWER PLANT UNDER SEISMIC EXCITATION. Chu, S. L.; Agrawal, P. K.; Singh, S. (Sargent and Lundy Engineers, Chicago). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of soil-structure interaction is often treated by using equivalent soil mass and spring coupled with the actual structure model in the dynamic seismic analysis where lumped soil mass and spring parameters are derived from the convenient assumption of a rigid plate resting on the elastic half space. It is well known that the use of those lumped soil parameters to characterize soil-structure interaction may produce a pronounced filtering of ground motion response magnitude at high frequencies. An improved method is presented to investigate the soil-structure interaction effect by the use of finite elements which is particularly suitable for buildings embedded in a shallow soil stratum. An example of two dimensional analysis is given to illustrate this method. It is observed that the effect of soil-structure interaction is negligible in lower frequency range; but the base slab response spectrum may be either amplified or de-amplified for the higher frequencies, in comparison with the free field ground response spectrum. Also discussed is the feasibility to extend this method to the three dimensional analysis. Finally, a method involving the generation of Fourier modulus and transfer function is discussed which would eliminate the step to obtain compatible rock motion. 12 references. (auth)

5524 (CONF-730942-P4, pp vp Paper K 3/1) ESTIMATED MODE OF FAILURES OF NUCLEAR POWER PLANTS BY POTENTIAL EARTHQUAKES. Shibata, H. (Tokyo Univ.); Akino, K.; Kato, H. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Estimated "mode of failures" of nuclear power plants which will be caused during violent earthquakes are analyzed. The mechanisms of failures are categorized as follows: (i) damaged by acceleration shock, (ii) by pseudo-resonance in acceleration wave, (iii) by resonance in acceleration wave, (iv) by resonance in displacement wave, (v) by seismic force slower than the natural period of building, equipment and so on, (vi) by external force from attached pipings and so on, (vii) by forced deformation and (viii) by liquefaction of soil. Also items of nuclear power plants are assorted as follows: (i) main building, (ii) auxiliary building, (iii) containment vessel, (iv) primary coolant system, (v) emergency cooling system, (vi) secondary coolant system, (vii) turbine, (viii) control rod system, (ix) safety shut down system, (x) refueling machine and crane, (xi) cooling pond, (xii) main power system, (xiii) emergency power supply, (xiv) control room instrumentation, (xv) air-conditioning system and stack, (xvi) underground pipings for cooling system, (xvii) auxiliary equipment and (xviii) auxiliary pipings. 5 references. (auth)

5525 (CONF-740501-, pp 418-438) SAFETY EVALUATIONS FOR GAS-COOLED REACTORS. Larrimore, J. A.; Moffette, T. R. (General Atomic Co., San Diego, CA). 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The safety characteristics, safety-related design features, and accident evaluations of HTGR and GCFR type reactors are described. The similarities and significant differences in the safety features of the two types are discussed. (JWR)

5526 (CONF-740501-, pp 439-462) FISSION PRODUCT CONTROL IN HTGR PLANTS. de Nordwall, H. J. (Oak Ridge National Lab., TN); Bell, W. E. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

Fission product control in a typical 2000 MW(t) HTGR plant is discussed in terms of (1) radiation dose guidelines as established by the AEC, (2) fission product pathways to the environment, (3) fission product distributions under normal and selected accident conditions, and (4) the physical models and basic data used to describe fission product transport. Six key fission nuclides, namely ^{3}H, ^{85}Kr, ^{90}Sr, ^{127m}Te, ^{131}I, and ^{137}Cs are taken to represent chemically and radiologically all significantly mobile fission products. Results of release calculations for the six nuclides show substantial margins (or safety factors) between acceptable (guideline) and predicted releases to the environment. For normal conditions, the smallest apparent margin, a safety factor of 22, is for ^{85}Kr. For accident conditions, the smallest apparent safety factor is 330, which is for ^{90}Sr in the design depressurization accident. (auth)

5527 (CONF-740501-, pp 463-471) ENVIRONMENTAL IMPACT OF HTGR STEAM ELECTRIC POWER STATIONS. Kelly, M. J. (Oak Ridge National Lab., TN); Kirslis, S. S.; West, R. G. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The high-temperature gas-cooled reactor steam electric power station has all of the potential environmental impacts associated with any large nuclear station. Construction impacts can be minimized by proper planning and are usually of limited duration. The potentially most significant impacts of station operation

result from the operation of the heat dissipation system. The use of cooling towers is assumed. The effects of salt deposition, fogging, and icing are expected to be minor. The magnitude of the adverse effects caused by intake and discharge such as entrainment of eggs, larvae, and fish and chemical impacts from blowdown can only be assessed for a specific site but may be significant. The impact of radionuclide releases, constrained by the as-low-as-is-practicable criteria, is small. The only environmental advantage over other reactor types is lower consumptive water use for the same net electric power production which can result in a smaller environmental impact. (auth)

5528 (CONF-740606-12) DESTRUCTIVE TESTING OF FLAWED 6-IN.-THICK PRESSURE VESSELS. Robinson, G. C.; Smith, J. E.; Whitman, G. D.; Derby, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1974. 24p. Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

A series of vessels are being destructively tested under the AEC-sponsored, ORNL-managed Heavy-Section Steel Technology (HSST) Program to evaluate the failure characteristics of thick-walled vessels. The design, material, fabrication, and inspection requirements of these vessels are representative of those of current light-water reactor vessels. The test facility, capable of controlled temperatures from −50 to +350°F (−45.6 to 176.7°C) and pressurization output to 50,000 psi (344.8 MN/m^2), is being utilized to produce failure in frangible, transitional, or tough modes. Part circular and semielliptical flaws are machined at various inside and outside locations in base materials and welds and are fatigue sharpened by a hydraulic pulsing technique to the required depth. Up to 100 channels of strain output are periodically recorded at frequent intervals up to the failure point during each test. Strain gaging techniques have been developed to permit recording of strains to 8% with the gage exposed to 35,000 psi (241.3 MN/m^2) and 200°F (87.7°C) water environment. Both acoustic emission and ultrasonic techniques are being used to monitor material behavior in the vicinity of the flaw. As of July 1973, five vessels have been tested with the remainder of the tests scheduled for completion during 1974. Data from the completed tests are reviewed and discussed. (auth)

5529 (CONF-740608-2) RADIAL EXPANSION REACTIVITY EFFECT IN THE FTR FOR HYPOTHETICAL UNSCRAMMED LOSS-OF-FLOW TRANSIENT. Coffield, R. D.; Starr, J. E.; Unterzuber, R. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. Contract AT(45-1)-2171. 3p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

Some results on a study of the core radial expansion effects on FFTF reactivity following a loss-of-flow transient are discussed. (JWR)

5530 (HEDL-SA-702) FFTF DESIGN FOR SAFETY. Simpson, D. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 20p. (CONF-740401-8). Dep. NTIS $4.00.

From conference on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

The FFTF is a major project of the AEC's LMFBR program, now under construction near Richland, Washington. Programmatic direction is provided by the AEC Division of Reactor Research and Development. The project is organized to apply the resources of the nation's laboratories and industrial organizations to a maximum extent. The design approach provides for three levels of safety, for defense-in-depth. Design safety criteria were established to guide the design by a defined relationship between classes of potential faults or malfunctions and acceptable consequences. A primary design emphasis is placed on reliability of normal operation. Design features and quality requirements are directed toward this goal, and supported by extensive component testing. Plant protective features provide for automatic reactor shutdown and heat removal in event of potential malfunctions. Additional margin for public protection in event of unexpected and unforeseen events is provided by a containment building. The FFTF design is undergoing an AEC regulatory review similar to that required for private reactor licensing. The construction authorization review has been completed; an additional review for authorization of reactor operation is yet to be carried out. (auth)

5531 (KFK-1900) STUDY ON A REACTOR SAFETY INFORMATION SYSTEM (RESI). Schultheiss, G. F.; Schlechtendahl, E. G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Feb 1974. 193p. (In German). Dep. NTIS (US Sales Only) $12.75.

Problems of information processing within the framework of the licensing procedures under the atomic energy law of the Federal Republic of Germany are reviewed. A proposal is submitted for the layout of an information system and its application. The fundamentals of the system concept, detailed investigations by inquiries, as well as the development of two prototype systems (RESI-1 and RESI-2) including demonstration performances are reported. The effects of experience obtained on the proposed system concept are described and a number of specific problems are discussed in more detail. Finally, the proposal of an experimental phase of approximately three years duration is explained with due consideration to the expenditure required and to possible operator organizations. The necessary decisions of the competent authorities are indicated, taking into account previously obtained research results. (auth)

5532 (LRD-2928-D) NUCLEAR POWER PLANTS SAFETY IN THE LIGHT OF THE 4TH GENEVA CONFERENCE. Svab, V. (Ceskoslovenska Akademie Ved, Prague. Laborator Radiologicke Dozimetrie). Dec 1972. 36p. (In Czech). INIS.

The results are summarized of research projects related to nuclear reactor safety and reported at the 4th Geneva Conference in 1971. An evaluation is made taking into consideration: the philosophy of safety; the protection of personnel and of population during normal operation and in case of accidents; problems of dosimetry; radiation damage of structural materials; radioactive wastes of all kinds; and legal aspects of operation and construction. Principal requirements for the design and the construction of nuclear plants implied by the papers are summed up. (INIS)

5533 (PB-226323) ACCUMULATION AND RELEASE OF TRITIUM IN PRESSURIZED WATER REACTORS. Final Report. Lentsch, J. W.; Hornyik, K.; Turnock, R. K. (Portland General Electric Co., Oreg. (USA)). Nov 1973. 169p. (PGE-8001). NTIS $4.75.

For Oregon State Univ., Corvallis.

Two computer codes, TRIT and THKK, each designed to predict tritium concentrations and inventories in light-water-cooled and -pressurized nuclear power plants are described and compared. Mathematical bases, input requirements, sample calculational results and program listings are presented for each code. While the codes are similar in purpose, they differ in that TRIT evaluates tritium concentrations only at the end of reactor power operation and refueling cycles, whereas THKK calculates tritium inventories at any desired day of startup, power operation, hot shutdown, or refueling. TRIT is simpler programmatically than THKK and the output from TRIT is more useful in evaluating controlled liquid discharge rates and resulting inplant and offsite exposures. THKK incorporates a greater amount of flexibility than TRIT, however, thus permitting detailed parametric studies and analyses of nonstandard plant operations to be performed. Both codes were written for application to the Trojan Nuclear Plant but have general applicability to PWRs of similar design. The amount of radioactive liquid discharged from a nuclear plant is regulated by the accumulation of tritium in the main and auxiliary water systems such that radiation doses to plant personnel and the public are within acceptable guidelines. Calculational results from the TRIT and THKK computer codes disclose that a Trojan-type nuclear plant will experience no difficulty in keeping tritium doses to plant personnel and the public within acceptable limits. Comparison of the results obtained from the two codes shows that the tritium concentrations calculated by the THKK code are consistently 4 to 10% lower than those calculated by TRIT. These differences are attributed to the independent approximations made in each code and are of little practical significance. (auth)

5534 (WASH-1232) BASIC PROPERTIES OF ICE AS RELATED TO THE PERFORMANCE OF ICE CONDENSERS. Soldano, B. A. (USAEC Directorate of Licensing, Washington, D. C.). Sep 1972. 18p. Dep. NTIS $4.00.

The basic properties of ice as related to its use as in heat sink and iodine scrubber in ice condenser systems for reactor containments are examined. (JMR)

5535 (ZJE-140) STUDY OF CRACK INITIATION AND ARRESTING CONDITIONS IN PRESSURE VESSEL MODELS WITH RESPECT TO ACCUMULATED ENERGY. Brulmovsky, M.; Filip, R.; Kalna, K.; Stepanek, S.; Urban, A. (Skoda, Plzen (Czechoslovakia)). 1973. 32p. (CONF-731003-6). Dep. NTIS (U.S. Sales Only) $3.75.

From 2nd international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

Research was performed at Skoda Works, Plzen, Czechslovakia, to study the safety criteria of reactor pressure vessels. The last four years of the research work and the most important results of the study are presented. Attention is paid to the analysis of the influence of accumulated energy in a pressurized medium on the

crack arrest temperature, which is taken as the basic criterion for pressure vessels (or pipelines) safety. Analysis of all results shows there exists a characteristic temperature, at which a crack, either brittle or fast shear, is arrested. Moreover, a comparison of this temperature with other temperature criteria is introduced. (10 figures) (auth)

5536 SITING CONSIDERATIONS FOR FUTURE OFFSHORE NUCLEAR ENERGY STATIONS. Klepper, O. H.; Anderson, T. D. (Oak Ridge National Lab., TN). Nucl. Technol.; 22: No. 2, 160-169(May 1974).

The range of applicability of present nuclear plant concepts has been assessed in relation to future nuclear plant siting needs. Future electrical generating requirements indicate a major potential need for offshore stations near the populous coastal states, and a survey has been made of the availability and characteristics of offshore sites. 21 references. (auth)

5537 AEC'S NUCLEAR SAFETY RESEARCH OBJECTIVES, PLANS, AND SCHEDULES. Kouts, H. J. C. (Atomic Energy Commission, Washington, DC). Nucl. Safety; 15: No. 2, 127-131 (1974).

The research objectives and program plans of the AEC's recently established Division of Reactor Safety Research are discussed. The primary objective of the Division is to provide information needed by the ACRS and the Regulatory Staff so as to avoid unnecessarily strict limitations on the operation of nuclear power plants. The means for satisfying public concern related to the safety of nuclear plants and the conservatism imposed by lack of knowledge, as being developed by the safety program, are discussed. The safety projects currently sponsored are all related to water-reactor safety, although safety studies relating to the HTGR and the LMFBR are planned. In addition to the LOFT and the PBF—two large programs which have been under way for some time— a number of smaller, more basic projects are also under way in the areas of blowdown heat transfer, two-phase pump characteristics, steam–water mixing, and primary-system integrity. Several additional water-reactor-safety projects, some being initiated and others being planned, are identified and discussed. 12 references. (auth)

5538 AEC TESTIMONY AT THE 1973 JCAE HEARINGS ON REACTOR SAFETY. Cottrell, W. B. (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 2, 132-145(1974).

In Phase IIA of the Joint Committee on Atomic Energy's Hearings on Reactor Safety, held Sept. 25–27 and Oct 1, 1973, the 5 AEC Commissioners and 12 of their staff presented testimony. This testimony, which is reviewed here as reported in the hearing record, was concerned with all aspects of Commission activities related to the nuclear power-reactor program, including (1) reactor safety research and development, (2) waste-management investigations, (3) the protection of materials and facilities, and (4) the AEC's regulatory activities as well as those of the Advisory Committee on Reactor Safeguards and the Atomic Safety and Licensing Board Panel. The presentations as a whole reflect tremendous activity on the part of the AEC to provide for the safe utilization of this energy resource. The presentation discussed in detail many actual and potential problems, including needed safety research, the accident-risk study, waste-management experience, sabotage, diversion, reactor licensing, inspection, operating experience, and standards development. 27 references. (auth)

5539 SAFETY ASSESSMENT OF REACTOR SYSTEMS. Green, A. E. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Safety; 15: No. 2, 154-162(1974).

The practice in the United Kingdom Atomic Energy Authority is to carry out independent reliability and safety assessments of those reactor systems on which safety is dependent. The independent assessment is complementary to the design process, and, when the results are in agreement, greater confidence is placed in proceeding with the development of the system or project. Presented are viewpoints in the United Kingdom on how safety of systems should be predicted, employing component failure probabilities interpreted in the light of "real-world" considerations. The type of safety assessment described has been successful in a number of applications, and these benefits are reviewed. 11 references. (auth)

5540 SUPPLEMENTARY NOTES ON THE BOOKLET "NUCLEAR ENERGY AND ELECTRICITY". Kommandeur, J.; Meijer, L. A. Ingenieur (Utrecht); 85: No. 28-29, 583-584(12 Jul 1973). (In Dutch).

Supplemental information on the main report on the booklet "Nuclear Energy and Electricity" is presented. Detailed technical information about the radiation hazards of nuclear power stations is included. (NL)

5541 REMARKS ON THE ARTICLE BY E. J. TUININGA. Mostert, P. Ingenieur (Utrecht); 85: No. 28-29, 594-596(12 Jul 1973). (In Dutch).

In addition to challenging the article on a number of specific technical and economic points, the present author accuses Tuininga of adopting an unduly pessimistic philosophy in general. Weinberg's approach to the "moral imperatives of nuclear energy" is, it is claimed, both more realistic and optimistic. (NL)

5542 OBJECTIONS TO NUCLEAR ENERGY: A SURVEY. Tuininga, E. J. Ingenieur (Utrecht); 85: No. 28-29, 588-594 (12 Jul 1973). (In Dutch).

The health, security and environmental problems of nuclear energy are reviewed in general, and their particular significance for nuclear power developments in the Netherlands is discussed. Even the economic benefits of nuclear power could prove illusory, it is claimed, when essential protective measures against all credible risks are realistically costed. (NL)

5543 "NUCLEAR ENERGY AND ELECTRICITY" IS A BEST-SELLER. Wasser, P. J. B. Ingenieur (Utrecht); 85: No. 28-29, 585-587(12 Jul 1973). (In Dutch).

Despite the objections voiced by the Dutch Union of Scientific Research Workers the booklet "Nuclear Energy and Electricity" has enjoyed a widely favorable reception. Various authoritative publications are invoked in specific rebuttal of many of the objections. (NL)

5544 OBJECTIONS TO GKN BOOKLET "NUCLEAR ENERGY AND ELECTRICITY". Kommandeur, J.; Meijer, L. A. Ingenieur (Utrecht); 85: No. 28-29, 581-583(12 Jul 1973). (In Dutch).

A report by a working party of the Dutch Union of Scientific Research Workers on the GKN booklet entitled "Nuclear Energy and Electricity" is presented. The booklet is roundly condemned as generally presenting a biased account of the merits of nuclear vis-a-vis fossil-fuelled power stations. Particular objections concern: the choice of economic ground rules, which give a misleading impression of the commercial advantages of nuclear generation; and undue emphasis on the pollution problems associated with the use of fossil fuels, without a balancing account of the radiation hazards of nuclear power stations. (NL)

5545 FLOATING NUCLEAR PLANTS: POWER FROM THE ASSEMBLY LINE. Carter, L. J. Science; 183: No. 4129, 1063-1065(15 Mar 1974).

The possibilities for the production of floating nuclear power plants by standardized assembly line methods are discussed. Some of the questions concerning public policy toward such a program are examined. (JWR)

5546 FORECASTING PUBLIC RESISTANCE TO TECHNOLOGY: THE EXAMPLE OF NUCLEAR POWER REACTOR SITING. Jopling, D. G.; Gage, S. J.; Schoeman, M. E. F. pp 53-66 of Guide to Practical Technological Forecasting. Bright, J. R. (Ed.). Englewood Cliffs, NJ; Prentice-Hall, Inc. (1973).

Information is presented concerning the adverse public reaction to the siting of nuclear power plants. The stages that this public resistance goes through are listed and discussed. (DCC)

5547 SAFETY OF A NUCLEAR POWER STATION IN VIEW OF OPERATIONAL EXPERIENCE. Shibata, M. (Kansai Electric Power Co. Inc., Osaka). Genshiryoku Kogyo; 19: No. 9, 31-35; 50(Sep 1973). (In Japanese).

The safety of nuclear power stations differs from that of ordinary industrial plants in that securing of safety has been fully studied from the very beginning. The following are described on the basis of operating experiences of Mihama PWR power plants: design policy for the whole plants, engineering safety facilities and radiation protection facilities; safety measures in operation, including check-up of machinery in operation, inspection, etc.; safety measures in maintenance and repair; safety guidance for contractors; improvement added after the completion of plants; and radiation control and monitoring in and outside the site. (JA)

5548 SOME PROBLEMS CONCERNING SAFETY OF NUCLEAR POWER PLANT IN JAPAN. Kawasaki, M. (Japan Atomic Energy Research Inst., Oarai). Genshiryoku Kogyo; 19: No. 7, 44-51(Jul 1973). (In Japanese).

The peaceful use of atomic energy entails safety assurance for nuclear power generation. The safety aspects of nuclear power plants and governmental safety examination are described on the following: failures in the Japan Power Demonstration Reactor and the investigations concerned; current procedure of the safety examination; presumed reactor accidents and hazard evaluation (mainly in case of loss of coolant); and evaluation of radiation exposure. In Japan, the evaluation of radiation exposure in the safety

examination is made for the external γ-ray exposure due to radioactive cloud and the internal exposure due to inhalation. (JA)

5549 PROBABILISTIC ASSESSMENT OF AIRCRAFT RISK FOR NUCLEAR POWER PLANTS. Wall, I. B. Nucl. Safety; 15: No. 3, 276-284(1974).

The risk to the public from an aircraft striking a nuclear power plant has been evaluated in a quantified manner. Aircraft accident data have been analyzed to estimate the probability of an aircraft striking a typical nuclear power plant at sites adjacent to and remote from an airport. In the event that an aircraft strikes a building, the region of impact is generally restricted to a local component. Two modes of significant damage are delineated: (1) perforation and (2) local collapse. Methods have been developed to estimate the conditional probabilities of such structural damage given an aircraft strike and probability values calculated for a representative structure. Actual risk to the public (probability vs. radioactive-release magnitude) may be estimated from a classification of critical safety components by their structural protection and the likely release magnitude in the event of their damage. All foreseeable releases either cause insignificant offsite dose or, for most sites, are associated with very low probabilities. A brief evaluation shows that fire upon impact is not a significant increment of risk. Comparison of these risks to socially acceptable risk levels shows that reactor sites beyond 5 miles from an airport or away from a busy air corridor should be acceptable. Other potential sites need individual examination, and, in some cases, hardening of the structure may be necessary. 22 references. (auth)

Reactor Theory and Calculation

Refer also to abstracts 5040, 5347, 5470, and 5647.

5550 (BNWL-SA-4935) STATUS OF EXPERIMENTAL CRITICALITY DATA FOR $(Pu,U)O_2$ FUEL RODS. Brown, C. L. (Battelle Pacific Northwest Lab., Richland, Wash. (USA)). [nd.] 7p. (CONF-740608-1). Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

Tables are presented on experimental criticality data for (Pu, U)O_2 fuel rods for LWR and LMFBR type reactors. (JWR)

5551 (CONF-740608-6) NEXT FLIGHT ESTIMATION FOR THE FICTITIOUS SCATTERING MONTE CARLO METHOD. Cramer, S. N. (Oak Ridge National Lab., Tenn. (USA)). 1974. 5p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

The elimination of the spatial integration in the exponential attenuation term of the next flight estimator by applying a one-dimensional fictitious scattering calculation along the line from collision site to detector point is illustrated. (JWR)

5552 (EURFNR-1160) MITRA: A PROGRAM FOR THE TRANSFORMATION OF THE OUTPUT OF MIGROS-2 INTO AN INPUT FOR GRUMA. Huschke, H.; Krieg, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1973. 60p. (KFK-1810). Dep. NTIS (U. S. Sales Only) $6.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The computer program representing the connection between the program system MIGROS-2 and the GRUBA management program GRUMA is described. The program MITRA tests the consistence of the output of MIGROS-2 which is written on an external storage unit and transforms this output into an input for the GRUBA management program GRUMA. MITRA is written in FORTRAN IV with the exception of one small ASSEMBLER routine and is presupposing the GRUBA library as used in Karlsruhe. (auth)

5553 (FEI-404) METHODS OF CALCULATING HEAT EXCHANGE FOR LIQUID METALS IN CORRECT LATTICES OF FUEL ELEMENTS AND SOME NEW EXPERIMENTAL DATA. Zhukov, A. V.; Matyukhin, N. M.; Muzhanov, A. B.; Sviridenko, E. Ya.; Ushakov, R. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 45p. (In Russian). Dep. NTIS (U.S. Sales Only) $5.25.

A more general solution than that found in the literature of the problem on the temperature field of fuel element lattices during turbulent flow is presented. A very simple approximate solution which is recommended for practical calculations is examined. An approximate semi-empirical solution is given of the problem on turbulent heat exchange in a fuel element bundle and it agrees satisfactorily with test results. All solutions are reported as simple relations whose coefficients are tabulated and constructed in the form of nomograms. New experimental data on the temperature fields of the core and the heat exchange in bundles with S/d = 1.06 are examined. A description is given of the test bundle and the methods for the measurements and processing of test results. The results obtained were analyzed and compared with the calculated results. (tr-auth)

5554 (IFA-FR-100-1973) REMUS: A CODE FOR MULTIGROUP SET REDUCTION FOR FAST REACTORS. Boeriu, S.; Cepraga, D.; Cristian, I.; Cuculeanu, V.; Slavnicu, D. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 5p. INIS.

The flux-flattening algorithm is used for reduction of multigroup cross sections to few-group cross sections. The program is written in FORTRAN IV for the ICL 1900 computer with a 40 K memory and is applicable to fast reactors. (auth)

5555 (JAERI-1228, pp 91-96) ROLE OF SPECTRUM MEASUREMENT IN FAST ASSEMBLY. Iijima, T.; Shirakata, K.; Mukaiyama, T. (Japan Atomic Energy Research Inst., Tokai). Jul 1973. (In Japanese).

The accuracy of spectrum calculation of a fast reactor system was examined, and it is revealed that the main source of the errors is the slowing-down cross-section. In the region above 10 keV the inelastic slowing-down matrix associated with ^{238}U is the most decisive for the accuracy, while below 10 keV the most sensitive to it is the method of derivation of the group constant. The accuracy of the calculated spectrum strongly affects the prediction of the reactor properties; therefore, it is essential to evaluate and improve the slowing-down cross sections from spectrum measurements. (auth)

5556 (ORNL-tr-2822) USE OF CARNAC CALCULATION PROGRAM. Bessis, J.; de Mareuil, M. (Societe d'Etudes des Problemes de l'Informatique et de l'Atome, 78-Versailles (France)). 14 Mar 1973. Translated by Martha Gerrard from SESR-N-5. 8p. Dep. NTIS $4.00.

The use of the CARNAC code in calculating the neutron fluence and energy distribution after a criticality accident in a moderated critical assembly is described. (JWR)

5557 EXAMINATION OF SOME APPROXIMATIONS FOR HETEROGENEOUS REACTORS. Clark, H. K. (E. I. du Pont de Nemours and Co., Aiken, SC). Nucl. Sci. Eng.; 54: No. 1, 55-71(May 1974).

The approximation inherent in using cell-averaged homogenized cross sections in computations for heterogeneous reactors is investigated for slab reactors by discrete integral transport (DIT) theory. Small, but significant, differences in reactivity and anisotropies in migration area are found. The DIT technique is extended to include an exact asymptotic reactor boundary condition and a separable transverse flux. Approximate solutions are investigated in which a reactor is subdivided into a number of zones with the coupling between zones expressed in terms of the directional currents at the interfaces. The sticking probabilities for these currents are derived from Taylor expansions of the source through linear terms. Generally good results are obtained when the zones correspond with the cells in a reactor. (auth)

5558 EVALUATION OF POWER DISTRIBUTION IN LARGE REACTORS USING A TWO GROUP NODAL METHOD. Graves, H. W. Jr. Ann Arbor, MI; Univ. of Michigan (1973). 117p. University Microfilms Order No. 74-3633.

Thesis (Ph. D.).

An analytical model for the fission power distribution behavior in a nuclear reactor is described which is extremely efficient relative to finite difference, few group diffusion theory, and which has considerably less dependence on empiricism than currently available nodal methods. The model treats two neutron energy groups in the nodal approximation, i.e., the reactor is subdivided into a two-dimensional array of nodes, or points, where each node is both a source and sink for neutrons, and where nodal interaction is treated by means of coupling coefficients between the nodes. The evaluation of these coupling coefficients is the central problem of the nodal method. These coefficients are functions of fuel assembly dimensions, the nuclear properties of the source node and surrounding nodes, and the neutron source distribution within each node. The dependence of the coefficients on the gross, or global neutron source distribution is suppressed. Intra-assembly source shapes are based upon proximity to the reflector and differences in nuclear properties between adjacent assemblies. A technique for evaluating the effects of a steel flow baffle plate between the core and reflector on neutron coupling between these regions is also developed. The method developed is compared with four finite difference diffusion theory test problems which cover a wide range of reactor size and fuel loading arrangements. Agreement to within 0.3% on eigenvalue and

10% on nodal power is demonstrated for cases without a steel baffle. The largest errors occur at the core-reflector interface. Empirical adjustment of the core-reflector coupling coefficients yields considerable improvement, and the adjustments made are relatively insensitive to core size and fuel arrangement. Agreement with a single large core test problem with a steel baffle between core and reflector was less satisfactory. The errors in source distribution for this case appear to be due to an overestimate of thermal neutron absorption in the baffle, so that empirical correction for the effect would also cover a wide range of cases. (Diss. Abstr. Int., B)

5559 USE OF CROSS-SECTION SELF-SHIELDING FACTORS IN FAST REACTOR CALCULATIONS. Gupta, H. P.; Kapil, S. K. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The cross-section shelf-shielding factors are often specified for certain values of background cross sections and temperatures. For the calculation of composition dependent group cross sections required for reactor design, interpolation of self-shielding factors is resorted to. Various interpolation schemes in use are compared for some representative reactor systems in terms of some parameters of interest such as buckling, reactivity, and Doppler coefficients. (auth)

5560 EFFECT OF NEUTRON TRANSIT-TIME ON COUPLED CORE NUCLEAR REACTOR KINETICS. Kalra, M. S.; Ram, K. S.; Sastry, V. R. (Indian Inst. of Tech., Kanpur). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Kinetics equations for a two-core coupled nuclear reactor, based on a point reactor model with one group of delayed neutrons, have been solved for (a) loss of coolant flow in core 1 taking temperature reactivity feedback into account, and (b) external reactivity insertions, to see the effect of neutron transit time, on the response of the reactor. It has been found that for negative reactivities either due to temperature reactivity feedback or due to control rod movement, transit time is not important. For positive reactivities up to prompt critical condition, effect of transit time is small. However, for conditions above prompt critical, transit time has significant effect on the reactor response, if the neutron lifetime is comparable to, or less than, the transit time. For strongly coupled systems, the effect of transit time will, in general, be more. (auth)

5561 METHOD OF COLLOCATION FOR POINT KINETICS USING PARABOLIC AND EXPONENTIAL FORMS. Kapil, S. K.; Gupta, H. P. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The method of collocation with the use of parabolic interpolation form in the point reactor kinetics is found to be inefficient for super-prompt critical reactivity states. As an alternative, the exponential form is considered in an effort to predict the behavior under super-prompt critical conditions. (auth)

5562 MONTE CARLO METHOD OF CALCULATIONS FOR FAST SYSTEMS. Subbukutty, K.; Godwal, B. K.; Iyenger, S. B. D.; Navalkar, M. P. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A method of Monte Carlo calculations for fast systems in general and fast critical facilities and pulsed fast reactors in particular was developed. The neutron spectrum in various zones of a fast critical facility and a "simulated experiment" for approach to criticality to estimate critical mass is reported. It is seen that the agreement between the actual and the estimated critical mass, estimated prior to actual criticality, is good considering counting statistics, errors in cross sections, and homogenization of the core. (auth)

5563 THEORETICAL LOOK AT THE NUCLEAR CROSS-SECTIONS FOR REACTOR APPLICATIONS. Garg, S. B.; Antani, S. N.; Srinivasan, L.; Kumar, A. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

An attempt is made to present a coherent account of nuclear cross sections, desired in the neutronics studies of nuclear reactors. Appropriate theories required to evaluate the energy-point cross sections in the resolved and unresolved resonance regions with suitable distributions of neutron and fission widths are described, and their relative merits are pointed out. The application of optical and statistical models in the high energy range to obtain total, inelastic and elastic cross sections, is also touched. In particular, the various techniques used in obtaining the multigroup cross sections are stressed. Finally, the rigorous calculations of the weighing factors by the fundamental mode technique, with P1, B1, consistent P1 and consistent B1 approximations, and their impact on group cross sections is considered. (auth)

5564 INTEGRAL TRANSFORM METHOD FOR MULTI-DIMENSIONAL NEUTRON PROBLEM WITH LINEARLY ANISOTROPIC SCATTERING. Sahni, D. C. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The integral transform method for multidimensional neutron transport problems developed for the case of isotropic scattering has been extended to include linearly anisotropic scattering. Explicity equations and their discussion are presented for criticality problems of a rectangular parallelepiped and a finite cylinder. (auth)

5565 MULTIGROUP CROSS-SECTIONS IN THE RESOLVED AND UNRESOLVED RESONANCE REGIONS USING ENDF/B DATA. Srinivasan, L.; Garg, S. B. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Multigroup cross sections have been generated in the resolved and unresolved resonance regions to study the neutronics of large dilute fast systems. In the unresolved resonance region, a Porter-Thomas distribution of neutron and fission widths has been used in order to calculate the energy point cross sections. The resonance parameters for s and p waves have been taken from the basic ENDF/B library. The MC^2-code which requires a 64K computer is suitably modified for the 32K-machine to carry out these computations. (auth)

5566 STOCHASTIC METHOD OF CALCULATIONS FOR FAST SYSTEMS. Godwal, B. K.; Navalker, M. P. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A stochastic method of calculations for fast systems in general and fast critical facilities and pulsed fast reactors in particular was developed. Both static and kinetic parameters, such as K_{eff}, prompt neutron lifetime, generation time, mean lifetime for fission, capture, and leakage, and neutron energy and time distribution of source neutrons are reported for a bare Pu system. The calculations are based on discrete time, discrete state Markov process. (auth)

5567 FAR SUBCRITICALITY MEASUREMENTS IN REFLECTED REACTORS BY THE CONJUNCTED PULSED NEUTRON METHOD. Stumbur, E. A.; Shokod'ko, A. G.; Zhuravlev, V. I.; Matveenko, I. P.; Milyutina, Z. N. At. Energ. (USSR); 36: No. 3, 178-181(Mar 1974). (In Russian).

Measurements of subcriticality in reflected reactors by usual integral pulsed methods lead to ambiguous results. Experimental and calculated verifications of an improved conjuncted pulsed method, using the integration of pulsed measurements results over the core with a weighting value function (or its equivalent), are given. It is shown that the conjuncted pulsed method makes it possible to determine the value of reactivity with an error of no more than 2%. (4 figures, 1 table, 10 references). (auth)

5568 DEPENDENCE OF THE NYQUIST STABILITY CRITERION ON THE CONTOUR AT INFINITY IN THE FREQUENCY-DOMAIN. Chandra, S.; Trasi, M. S. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

It is shown that the Nyquist stability criterion leads to the same result irrespective of the contour at infinity in the frequency plane, provided certain conditions of validity of the criterion are satisfied. When these are violated, the transformed contour depends on the contour at infinity in the frequency plane, and application of the criterion can give rise to erroneous results. (auth)

5569 SUBCRITICALITY DETERMINATION USING A NOVEL INVERSE KINETICS TECHNIQUE. Yang, C. Y. Seattle; Univ. of Washington (1973). 102p. University Microfilms Order No. 74-2240.

Thesis (Ph. D.).

A highly efficient and bias-free inverse kinetics technique is developed and applied to determine the subcriticality of a reactor. Most previously developed inverse kinetics algorithms are biased because of a reciprocal relation between the subcriticality of interest and the quantity (e.g., the multiplication) to be estimated. One other is biased due to the prompt rod-drop approximation. To eliminate these biases, the point kinetics equations are solved for the neutron source strength in terms of the integrated neutron flux so that the subcriticality can be estimated directly and without bias. No prompt rod-drop assumption is needed in applying this technique and thus the rods may be dropped instantly or slowly. The integrated flux, instead of the instantaneous one, is used in order to reduce the effect of noise. In the least-squares fitting employed for the reactivity search, the sensitivity on the trial value of the subcriticality is improved by the use of a curve-fit function consisting of four exponentials rather than a simple linear function. (Diss. Abstr. Int., B)

5570 APPLICATION OF THE METHOD OF POISONING FOR DETERMINATION OF THE DIFFUSION AND THERMALIZATION CONSTANTS OF THERMAL NEUTRONS IN HETEROGENOUS LIGHT WATER LATTICES. Khristov, V. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 24: 171-179(1973). (In Bulgarian).

The method of poisoning in diffusion experiments in heterogenous media is applied for the first time. Certain advantages of the method compared to the pulse method with respect to the more unambiguous determination of longitudinal and transversal coefficients of the diffusion cooling. The diffusion constants and the diffusion length for thermal neutrons in heterogenous light water lattices with hollow cylindrical canals (a = 1.8 cm, p = 0.3198) and in a lattice with elements of PbO(B) equivalent to the uranium light water lattice of the IRT reactor, are determined by this method. The obtained experimental data confirm the conclusion that the coefficients of diffusion length, calculated according to the Birens theory show evidently increased values which is probably related to the approximate character of the theory. (auth)

5571 THEORY OF POWER REACTOR NOISE. I. Saito, K. (Hokkaido Univ., Sapporo). Ann. Nucl. Sci. Eng.; 1: No. 1, 31-48 (Jan 1974).

An operating reactor has intrinsically fluctuating components in its state variables such as the thermal power, the outlet coolant temperature, the occupied region of control rods, etc. The fluctuations are generically called reactor noise, the analysis of which, both theoretically and experimentally, is one of the major problems in nuclear science and engineering. The ultimate aim of the analysis lies in presenting a systematized method of diagnosis of abnormality and malfunction of reactor components. The physical-mathematical analysis of reactor noise can be regarded as a branch of statistical physics. An attempt is made to clarify the underlying physical-mathematical concepts which have been and will be used in developing the operating reactor noise theory. Various analytical models used are summarized and explained. (UK)

Reactor Components and Accessories

Refer also to abstracts 3836, 3837, 3853, 3854, 3896, 3912, 3913, 5414, and 5524.

5572 (CEA-CONF-2577) RECENT DEVELOPMENT IN NUCLEAR PRESTRESSED CONCRETE PRESSURE VESSELS IN FRANCE. Costes, D.; Riquois, R.; Lacroix, R. (CEA, 75 - Paris (France); Electricite de France, 75 - Paris; Societe d'-Etudes des Caissons Nucleaires, 75 - Paris (France)). [nd]. 27p. (CONF-731003-7). Dep. NTIS (U. S. Sales Only) $4.50.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

The special characteristics of prestressed concrete pressure vessels are reviewed. Their safety, reliability, and regulation are discussed. Research and development on prestressed concrete pressure vessels in France is described. (JWR)

5573 (CONF-730942-P4) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 4. Reactor Plant Structures and Containment. Part J. Loading Conditions and Structural Analysis of Reactor Containment. Part K. Seismic Response Analysis of Nuclear Power Plant Systems. Preprints of 2nd International Conference, Berlin, Germany, September 10-14, 1973. Jaeger, T. A. (Comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 497p. (In English and German).

Separate abstracts are included for each of the 42 papers presented concerning loading conditions and structural analysis of reactor containment, and seismic response analysis of nuclear power plant systems. (DCC)

For abstracts of individual papers see: 5339-5344, 5369-5372, 5388, 5414, 5424, 5491, 5492, 5519-5524, and 5574-5594.

5574 (CONF-730942-P4, pp vp Paper J 3/3) DESIGN OF MISSILE RESISTANT CONCRETE PANELS. Doyle, J. M. (Univ. of Illinois, Chicago); Klein, M. J.; Shah, H. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Protection against structural failure in case of accidental impact of several types of projectiles must be a consideration in nuclear power plant design. The critical nature of certain items of equipment makes it necessary to surround some areas of the plant with missile resistant structures. Ordinarily, missile barriers consist of reinforced concrete walls, roofs and floors. A design procedure for rectangular concrete panels subject to various types of missile impact is outlined. 3 references. (auth)

5575 (CONF-730942-P4, pp vp Paper J 3/4) PROBLEMS AND GAPS OF KNOWLEDGE IN THE ASSESSMENT OF THE RESPONSE OF REINFORCED CONCRETE STRUCTURES UNDER IMPACT LOADING. Struck, W.; Limberger, E.; Eifler, H. (Bundesanstalt fuer Materialpruefung, Berlin). 1973. (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The potential danger of special equipments in chemical industry and power reactor plants and the possible serious harm for the employees and for the occupants require that impact loading must be taken into consideration in the dimensioning of building structures, especially in the case of containment structures. From the technical and economical point of view it is often necessary to take advantage of the ultimate load carrying capacity of such structures against impact loading. But in the special field of "impact loading" there are many problems yet to be solved and many gaps in knowledge. Impact loading and impulsive loading problems especially on structures made of reinforced concrete are analyzed. 34 references. (auth)

5576 (CONF-730942-P4, pp vp Paper K 1/3) PROBABILISTIC ASSESSMENT OF SEISMIC RISK FOR NUCLEAR POWER PLANTS. Chelapati, C. V. (California State Univ., Long Beach, CA); Wall, I. B. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Probabilistic approaches to the design, siting, and safety analysis of nuclear power plants have been proposed by Farmer, Wall, and Garrick. Farmer and Wall established a limit-line which delineates between acceptable risks. To implement the method, all accidental chains are systematically analyzed to determine their probability and associated fission product release magnitude; the combination is compared to the limit-line. For proper implementation, the seismic risk should be evaluated in a quantified manner. The effect of uncertainty in several parameters which determine the response of a nuclear reactor building to earthquake forces is assessed. Probability distributions for material properties were determined from site measurements. These distributions were utilized for determining the building response and the damage criterion. A subjective probability density function for damping was assigned from the available information and the judgment of experienced engineers. Four accelerograms, El Centro N-S 1940, and three artificial earthquakes were used to represent the variability in the forcing functions. The uncertainty in the model idealization was assessed by evaluating three alternate models. A versatile computer program was developed to compute the response of the mathematical model to the forcing functions using matrix formulation and modal method of analysis. An exact solution, rather than numerical integration was used to obtain the dynamic response of the system in generalized coordinates. 18 references. (auth)

5577 (CONF-730942-P4, pp vp Paper K 1/4) STOCHASTIC CONCEPTS IN SEISMIC DESIGN OF NUCLEAR POWER PLANTS. Singh, M. P.; Singh, S.; Chu, S. L. (Sargent and Lundy Engineers, Chicago). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the design of a structure for seismic excitations, the design earthquake is usually characterized by a set of free field response spectra which are prescribed on the basis of regional seismicity and professional judgment. However, in nuclear power plant designs, sometimes a more complete characterization of seismic

motion is needed to obtain reliable results. This may be provided for by stochastic modeling of seismic excitations, and it is now well acknowledged that such modeling is very desirable. In view of this, an attempt to use the stochastic approach in seismic design of nuclear power plant problems is made. A viable and practical approach utilizing currently available information and professional experience on the subject is suggested, wherein to characterize the design earthquakes, a 3-term spectral density function consistent with the prescribed broad-band response spectra, is used. How this stochastic modeling can be adopted in response analysis of nuclear reactor facilities, subjected to one or more components of earthquake motions, is described. The response evaluation of primary structural systems, generation of floor response spectra of a building, response of a secondary system, soil-structure interaction, etc. are discussed. Numerical results of several problems typically encountered in a nuclear power plant design are presented. The proposed approach is evaluated by comparing its results with the results of time history and response spectrum analyses. 11 references. (auth)

5578 (CONF-730942-P4, pp vp Paper K 2/3) INFLUENCE OF SOIL/STRUCTURE INTERACTION PARAMETERS ON FLOOR RESPONSE SPECTRA. Costantino, C. J.; Miller, C. A. (City Coll., New York). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The seismic design of equipment mounted within Reactor Containment Buildings (RCB) is usually based upon floor response spectra. The spectra are calculated by performing a dynamic analysis of the RCB subjected to the criteria free-field seismic disturbance. A major uncertainty in this calculation lies in the transformation of the free-field motion to loads acting on the structure (i.e., structure/media interaction). An approximate interaction law is used to compute the dynamic response of the Fast Flux Test Facility (FFTF) RCB to the Taft earthquake. Response spectra are calculated at critical points within the facility for a wide variation in the parameters of the interaction model. 7 references. (auth)

5579 (CONF-730942-P4, pp vp Paper K 2/6) SOIL-STRUCTURE INTERACTION PARAMETERS FOR A NUCLEAR CONTAINMENT VESSEL. Hall, J. R. Jr. (E. D'Appolonia Consulting Engineers, Inc., Pittsburgh); Morrone, A. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Considerable effort is spent on the analysis of a nuclear containment vessel to account for soil-structure interaction. In instances where the soil beneath foundation is relatively uniform, soil-structure interaction may be accounted for using theoretical solutions for a rigid foundation on an elastic half-space. These solutions indicate that the wave propagation and inertia effects of the soil have a pronounced influence on damping of the soil-structure system. Elastic half-space solutions for horizontal and rocking motions of a foundation in the form of frequency dependent displacement functions were utilized to study the response of a multiple degree of freedom lumped mass model of a typical containment vessel to ground motion input. The non-proportionally damped system response was solved assuming a unit harmonic ground motion input. Shear wave velocities were varied to represent soils ranging from that of a soft clay to a hard rock. Structural damping was assigned a value of two percent for all cases. The results of the analysis were used to derive an equivalent proportionally damped model that could be analyzed using more conventional techniques. The results and conclusions derived from the study are presented. 3 references. (auth)

5580 (CONF-730942-P4, pp vp Paper K 3/2) STRUCTURAL DYNAMICS BY FINITE ELEMENTS: MODAL AND FOURIER ANALYSIS. Carmignani, C. (Univ., Pisa, Italy); Cella, A.; De Paulis, A. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The increasing use of finite element discretization in the prediction of the dynamic behavior of complex structures is bounded by obvious restraints in the computational hardware and budget. Several approaches have been developed: the comparison is conditioned by the nature of the loads and by the structural type. Two approaches are briefly described in their implementation: (i) modal superposition; and (ii) Fourier transform. The numerical evaluation of the two approaches is extended to several structural types (frames, plates, shells) under different mesh partitions and loads, and is performed on the basis of the accuracy of the results, total computation time, and memory requirements. Particular emphasis is placed upon the prediction of the dynamic behavior of large scale structures under seismic type loads. 11 references. (auth)

5581 (CONF-730942-P4, pp vp Paper K 3/3) COMPUTATIONAL METHOD FOR DYNAMIC ANALYSIS OF STRUCTURES WITH LARGE SIZE STIFFNESS AND MASS MATRICES. Applications to Seismic Analysis. Brusa, L.; Ciacci, R. (CISE, Milan). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The dynamic analysis of complex structures is conveniently performed by means of the finite element method. If modal analysis is considered, the most important computational problem is the solution of a generalized eigenvalue problem in which matrices are often large and sparse. In the discrete analysis the number of modes of vibration is equal to the finite number of degrees of freedom but, for practical purposes, only the first few modes of vibration must be computed. The efficiency of an iterative method, based on the simultaneous iteration scheme, is evaluated. The particular structure of this iteration scheme allows, like in the static case, the use of a "frontal technique" which assembles and solves symmetric positive definite equations taking into account the sparseness of the matrices. This technique is more involved than the standard band-matrix algorithms but is more efficient for two and three-dimensional problems. A computer program, based on this numerical model and using isoparametric elements, has been coded to study dynamic problems for two-dimensional structures. The efficiency of the iterative scheme has been evaluated by means of numerical comparisons with the Householder-Givens method. Finally, illustrative results of earthquake response analysis are presented. 16 references. (auth)

5582 (CONF-730942-P4, pp vp Paper K 3/4) APPLICATION OF THREE-DIMENSIONAL NORMAL MODE THEORY TO SEISMIC ANALYSIS OF NUCLEAR POWER PLANTS. Scavuzzo, R. J. (Rensselaer Polytechnic Inst. of Connecticut, Inc., Hartford); Raftopoulos, D. D.; Bailey, J. L. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An extension is presented of three dimensional normal mode theory to include arbitrary foundation rotation about any of three orthogonal axes in addition to arbitrary foundation translation. Numerous technical papers have established the significance of soil-structure interaction in the seismic analysis of nuclear power plants. Often equivalent soil springs are evaluated on the basis of dominant vibration modes in various directions. By making use of the proposed theory, the reactions of inertia forces to the ground in each mode of vibration are determined. Therefore, a more exact evaluation of the frequency dependence of the soil response can be obtained than with fixed springs. Since all modes of vibration are coupled, the soil responses in each direction are defined for each mode. A numerical evaluation of a simple system is presented. Results are compared to computations made using other methods of analysis. 10 references. (auth)

5583 (CONF-730942-P4, pp vp Paper K 3/5) PROBABILISTIC FREQUENCY VARIATIONS OF CONCRETE STRUCTURES. Hadjian, A. H. (Bechtel Power Corp., Los Angeles); Hamilton, C. W. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The probabilistic distribution of the structure frequencies is analyzed using data on the variation of the material properties. Published empirical distributions of the modulus of elasticity and beam deflections are used in this process. The latter is used to obtain probabilistic distributions of the EI product (Modulus of elasticity × Moment of inertia). The fundamental distribution for E is determined through its relation to the compressive strength of concrete by $E = 33\ W^{3/2}\sqrt{f'_c}$. Thus, for a prismatic beam, the frequencies are related to the fourth root of f'_c and the implied distribution of the frequencies may be derived. Also since beam deflections are lognormally distributed, the frequencies are to be proportional to the reciprocal of lognormal random variables. Tables for both the E only and the EI analyses are developed, showing the nominal frequencies, their expected values, variances and confidence intervals at 80%, 90%, and 99%. The solution is extended to lumped parameter systems using matrices where it is assumed that the stiffness matrix is affected probabilistically by a scalar multiple of EI. Furthermore, frequency variations of systems including soil-structure interaction effects are studied. An appropriate choice of coordinates uncouples the structure stiffness coefficients from the lumped soil-structure interaction compliances. This allows the independent application of variabilities to the super-structure and the soil-structure interaction lumped parameters. Additional examples are provided. 8 references. (auth)

5584 (CONF-730942-P4, pp vp Paper K 4/2) FLOOR RESPONSE SPECTRA BY THE USE OF A MODIFIED WHITE NOISE TECHNIQUE. Lazzeri, L. (CNEN, Rome). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of computing the floor response spectra at various levels of a nuclear power building is studied. The case of a stationary white noise power spectral density is considered as of special importance as the amplification factor (i.e., the ratio of the accelerations of the equipment and of the structure at the point of connection) can be derived in a closed form independent from the frequencies of the structure and equipment and dependent only on their ratio. The importance of the stationary hypothesis is discussed and finite length correction factors introduced. All this procedure is available on a computer by means of the ad hoc program CFRS. Typical cases of response spectra have been considered and discussed; the applicability of the white stationary noise analysis has been studied and the validity range for such a simplified and compact analysis derived. A comparison with other standard methods (time history, etc.) is provided. 10 references. (auth)

5585 (CONF-730942-P4, pp vp Paper K 4/3) COMMENTS ON FLOOR RESPONSE SPECTRA. Chen, C. (Gilbert Associates, Inc., Reading, PA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For seismic resistant design of light equipment, the time history method is the most popular one to generate floor response spectra in the U. S. The advantages and pitfalls of this method are discussed, and methods of obtaining reliable spectra are recommended. As alternatives, Biggs Method, Newmark Method and the method based on random vibration theory are presented and discussed. 11 references. (auth)

5586 (CONF-730942-P4, pp vp Paper K 4/5) SEISMIC ANALYSIS OF THIN SHELL STRUCTURES. Kalnins, A. (Lehigh Univ., Bethlehem, PA); Godfrey, D. A. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A vertically erected, axisymmetric shell, resting on a horizontal foundation is considered. The only contact between the shell and the foundation is at the circular edge of the shell which touches the foundation. Such a structure can represent the containment shell, which houses a nuclear reactor, or a cooling tower, which is used to discharge the thermal effluents of a nuclear power plant into surrounding atmosphere. The foundation is subjected to a time-dependent motion in both the vertical and horizontal directions. The motion may be produced by an event such as an earthquake or explosion. It is assumed that a sufficient number of time histories of the motion of the foundation, caused by such events, is known. An estimate of the response of the shell to an event that is going to occur in the future is calculated. 7 references. (auth)

5587 (CONF-730942-P4, pp vp Paper K 4/8) SEISMIC ANALYSIS OF LONG BURIED STRUCTURES. Yeh, G. C. K. (Bechtel Power Corp., Norwalk, CA). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Nuclear reactor facilities often include segments of long tubular structures such as cooling water intake conduits, electrical ducts and water well casings which are buried underground. During an earthquake such a buried structure responds to various waves propagating through the surrounding soil as well as to the dynamic differential movements of the buildings to which the structure is connected. A rigorous analysis of the problem should consider the time-dependent stresses in the structure due to all the causes simultaneously. Such an analysis is beyond the state of the art at present. For design purposes a procedure is presented to estimate the stresses due to various effects separately and then combine them properly. The resulting stresses can then be further combined with other applicable design stresses to satisfy the specifications. The portions of the buried structure far from the ends are assumed to move with the ground under the propagation of seismic waves. Under this assumption formulas for axial, bending and shear stresses due to a shear wave obliquely incident upon the structure are available in the open literature. The corresponding formulas for stresses due to an oblique compressional wave are derived, a maximizing procedure to determine the maximum possible combined axial and bending stresses due to a single oblique shear or compressional wave is presented and decomposition of a surface wave into components of shear and compressional waves is demonstrated. For design purposes the stresses due to various types of seismic waves should be combined conservatively. However, over-conservatism should be avoided by realizing that due to differences in wave velocities the maximum stresses due to compressional waves, shear waves and various kinds of surface waves do not occur simultaneously. 9 references. (auth)

5588 (CONF-730942-P4, pp vp Paper K 4/9) RESPONSE OF UNDERSEA NUCLEAR POWER PLANTS DURING EARTHQUAKES. Akkas, N. (Middle East Technical Univ., Ankara). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A complete study of structures built under water must include the dynamic analysis, because these structures will inevitably be under the effects of some dynamic forces. For this reason a random forcing function representing a seismic excitation is chosen as a dynamic force. 13 references. (auth)

5589 (CONF-730942-P4, pp vp Paper K 5/5) EXPERIMENTAL STUDY ON THE RESPONSE OF A MODEL SYSTEM TO NATURAL EARTHQUAKES IN THE FIELD AND ON A SHAKING TABLE. Yamamuro, M. (Chubu Electric Power Co., Nagoya, Japan); Shinkai, T.; Kasugai, H.; Kurogochi, T.; Shibata, H.; Shigeta, T. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The observations of the responses of a three story building, equipment and piping models to natural earthquakes and those of the identical system on a shaking table are presented. Several methods of response analysis which are generally used in the standard practice of earthquake resistance design of nuclear power plants are compared. 3 references. (auth)

5590 (CONF-730942-P4, pp vp Paper K 5/6) EXPERIMENTAL STUDY ON PCRV-SUPPORT STRUCTURES UNDER SIMULATED EARTHQUAKE MOTION. Suzuki, T.; Wakamatsu, K.; Takeda, T.; Matsumoto, T. (Ohbayashi-Gumi, Ltd., Tokyo). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

One of the experimental series for PCRV structures integral with the reinforced concrete support that appear feasible is analyzed. The behaviors of the models under a static or dynamic load are compared with analytical results and discussed. Each model used in the tests consists of a steel mass representing PCRV and a reinforced concrete hollow cylinder support. The dimension of the support is considered to be about 1/50 scale of prototype design. The models with variable heights and sectional dimensions were subjected to periodic or simulated earthquake motions at their base. For better understanding of their behaviors, static tests were performed, too. (auth)

5591 (CONF-730942-P4, pp vp Paper K 6/1) STOCHASTIC PREDICTION OF MAXIMUM SEISMIC RESPONSE OF LIGHT SECONDARY SYSTEMS. Singh, A. K. (Sargent and Lundy Engineers, Chicago); Ang, A. H. S. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A stochastic model is presented for predicting the elastic response of light multi-degree-of-freedom secondary systems to strong motion earthquakes. Within the framework of the normal mode method, a decoupled stationary random vibration model is developed based on the assumption of Gaussian response process and Poisson barrier crossings. The accuracy of the proposed model is verified by comparing the calculated responses, at the 10% and 50% probability of exceedance level, with the second highest and average of the time-history responses from eight normalized accelerograms. The influence of decoupling, i.e., ignoring the dynamic interaction between the primary and the secondary systems, on the response is examined. The influence of nonstationarity is also evaluated. It is observed that nonstationarity is unimportant for earthquakes of relatively long duration, and that for a given damping most of the error can be accounted for by a simple scaling. It is also shown that one aspect of the proposed method constitutes the basis for some of the approximations in the response spectrum method; however, the proposed method yields results that are consistently more reliable than the response spectrum method. Moreover, results obtained with the proposed method represent maximum response statistics from an ensemble of earthquakes rather than a single earthquake. 9 references. (auth)

5592 (CONF-730942-P4, pp vp Paper K 6/2) RESPONSE SPECTRUM ANALYSIS OF BUILDING APPENDAGE SYSTEM TO AN ARTIFICIAL EARTHQUAKE WITH TWO GROUND PREDOMINANT PERIODS. Sato, H. (Tokyo Univ.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Data and procedure are presented of the aseismic design of the appendage system which is attached to the building system with

small mass ratio. This simulates that the appendage system such as piping and other auxiliary machine structure system is often on the floor of the main building. As the result the whole structure system is dealt with as two-degrees-of-freedom. Then it is attempted to apply the aforementioned approach extensively to the response spectrum analysis of the appendage system. In spite of that the simulation with single ground predominant period was fairly effective for the spectrum of the building system, the magnitude of the amplification factor of the appendage system by the simulation was much larger than that by the earthquake motion for a case of comparable system parameters. This difference is well explained again by taking the two ground predominant periods into account for the artificial earthquake not only in the magnitude but also in the shape of the spectrum. 11 references. (auth)

5593 (CONF-730942-P4, pp vp Paper K 6/6) SEISMIC ANALYSIS OF CRACKED REACTOR VESSELS. Hegarty, R. F.; Ariman, T. (Univ. of Notre Dame, IN). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The dynamic response of a finite circular cylindrical elastic shell, representing a nuclear reactor vessel, due to seismically induced forces is investigated. A longitudinal through crack of finite length exists in the vessel wall. Seismically induced force consists of any time dependent symmetrical surface and/or edge loads expressible with a Fourier series expansion. The governing equations of the analysis are the so called Morley equations which are extended into the dynamical case. These equations have nearly the same simple form as the well-known Donnell equations but include no further assumptions than those basic to linear thin-shell theory. Extensive numerical results are presented and some specific and axisymmetrical seismically induced forces and comparisons with those of a non cracked similar shell are discussed. The effect of dynamic loading on the stability of the crack and the relations between critical loads and crack lengths are also investigated. Furthermore free vibration problem of the cracked cylindrical shell is analyzed. Since free vibrations occur in the absence of all external loads, the homogeneous system of governing equations with homogeneous boundary conditions is considered. The effect of the crack on the natural frequency of the vessel is clearly demonstrated. 14 references. (auth)

5594 (CONF-730942-P4, pp vp Paper K 7/4) SEISMIC RESPONSE ANALYSIS OF UNDERGROUND PIPELINE FOR EMERGENCY CORE COOLING SYSTEM IN NUCLEAR POWER PLANT. Yamada, T.; Ogihara, Y. (Taisei Corp., Tokyo). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The aseismic design of the emergency core cooling system which is essential to the prevention of hypothetical accidents should be required to ensure the safety of nuclear power plant under severe earthquakes. The analysis of underground pipeline stresses due to soil cracks during earthquakes is presented. Stress analysis of underground pipelines are carried out using a mathematical model subjected to soil cracks. Both tension-type and slip-type cracks of the soil are considered in establishing the equation of equilibrium in which the effects of interaction are incorporated. The solution to the equation and the evaluation of stresses in the pipeline are shown, which may be useful for the aseismic design of a nuclear power plant. 5 references. (auth)

5595 (HEDL-SA-631) PRESSURE WAVE TRANSMISSION IN A FLUID CONTAINED IN A PLASTICALLY DEFORMING PIPE. Fox, G. L. Jr.; Stepnewski, D. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1973. Contract AT (45-1)-2170. 25p. (CONF-740606-6). Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

The transmission of high pressure pulses through piping loops such as reactor cooling systems is usually studied with water hammer analysis techniques. Conventional wave analysis includes only elastic pipe wall deformation. However, plastic deformation of the pipe wall is effective in reducing the magnitude of transmitted pressure waves if the pressure is of sufficient magnitude to cause plastic yielding. This effect can be treated using a one-dimensional dynamic analysis by noting the similarity between the equations describing pressure wave induced plastic deformation in a solid bar and wave transmission causing plastic strain in a fluid filled pipe. The results of the analysis show that at fluid pressures less than the pipe yield pressure, waves are transmitted at elastic wave velocity; however, at pressures which exceed the pipe yield point, wave velocities are substantially reduced and the waves are dispersed. These results demonstrate that plastic deformation from transient pressure loading is limited to a relatively short length of piping near the source of the pressure pulse. The significance of this behavior with respect to reactor cooling systems is that pressures above those causing yield are not transmitted to primary loop components such as pumps and heat exchangers. The theoretical results are compared with experimental tests and show reasonable agreement. (auth)

5596 (IAEA-126) BASIC STRUCTURAL DESIGN PHILOSOPHY, CRITERIA AND SAFETY OF CONCRETE REACTOR PRESSURE VESSELS. Report of a Panel, Vienna, February 9–13, 1970. (International Atomic Energy Agency, Vienna (Austria)). 1970. 254p. (CONF-700213-).

Separate abstracts were prepared for each of the 9 papers included. (JWR)

For abstracts of individual papers see: 5346, 5415, and 5597–5603.

5597 (IAEA-126, pp 19-51) STRUCTURAL DESIGN PHILOSOPHY AND CRITERIA FOR CONCRETE REACTOR VESSELS: U. S. PRACTICE. Rockenhauser, W. (Westinghouse Electric Corp., Pittsburgh). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

Prestressed concrete reactor pressure vessels technology is very young and codified. Standards have not yet been established. However, efforts are being made in the U.S., as well as in Europe, to write uniform "tentative criteria" or "recommended practices" which could eventually become the codes for design and construction of these vessels. Tentative criteria and design standards for the first U. S. PCPV, the Ft. St. Vrain reactor are described. A comparison of European and U. S. standards and a brief discussion of the relative merits of the various approaches are presented. (auth)

5598 (IAEA-126, pp 53-59) CONTRIBUTION FROM THE UNITED KINGDOM. Davidson, I. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

The following organizations are concerned in the UK:- two design and construction companies, two customer organizations, the Inspectorate of Nuclear Installations, and the Atomic Energy Authority. The basic philosophy in the UK is to provide adequate pressure relief valves on each PCRV, to design for the working loads, and for a nominal ultimate load factor, to test models, to carry out a pressure test and to monitor each vessel throughout its life. A committee of the British Standards Institution has almost completed the first Code of Practice, in line with the philosophy summarized. It is hoped to extend the Code to cover Limit State Design. It is suggested that more knowledge about the long term properties of concrete under working conditions would be advantageous, and could be facilitated by international collaboration. (auth)

5599 (IAEA-126, pp 61-68) WORK ON REACTOR VESSELS OF PRESTRESSED CONCRETE IN YUGOSLAVIA. Petrovic, B. (Inst. za Ispitivanje Materijala Sr. Srbije, Belgrade). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

The design for a two-wall concrete reactor pressure vessel model has been developed in Yugoslavia. The external vessel is prestressed with steel cables in the usual way. There are no cables in the internal vessel and this vessel is prestressed by a hydraulic system, inserted between the outer and the inner vessels. Calculations show that, for such a vessel conception, savings could be made of about 25 percent in cables and about 40 percent in concrete, using at the same time the same prestressing as for single walled vessels. At present, the model of such a vessel type is under construction in the Institute of the SR Serbia for Testing Materials in Beograd. The results of mathematical analyses of the action of seismic forces are discussed. (auth)

5600 (IAEA-126, pp 69-83) PROBLEMS AND PROSPECTS OF PRESTRESSED CONCRETE VESSELS: FRENCH EXPERIENCE UP TO 1970. Costes, D. (CEN de Saclay, Gif-sur-Yvette, France). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

After an historical survey of French background in PCPV's, the coordinated program carried out or long term stressing, development of new concretes, heat transfer studies, and development of insulation technologies, calculation programs,

measurements on actual vessels, and some design problems are described. Basic and safety problems in nuclear applications are discussed. The general safety standard is very high, but the ability to warn before failure due to weakening of some component is not always established. The French official regulation draft for gas reactor PCPV's is summarized. The economics for PCPV's is commented upon. (auth)

5601 (IAEA-126, pp 85-97) TEST STAND FOR THE PRESTRESSED CONCRETE VESSEL CONTAINING THE HELIUM LOOP. Komoli, L. H. (Reaktorzentrum, Seibersdorf, Austria). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

The planned large scale PCRV-Model has the following new features: hot liner (300°C), elevated temperature in the concrete vessel wall (up to 120°C), and a heating-cooling system in the wall to maintain temperature at the desired level. Preliminary R & D work underway includes high temperature insulating concrete, structural concrete and prestressing steel at elevated temperatures, and high temperature instrumentation. The vessel is to be erected at the site of the Reactor Center Seibersdorf, Austria, late 1970, to be tested with hot water 1971 (water reactor conditions) and start Helium-tests 1972. Design and erection: Reaktorbau Forschungs- und Baugesellschaft mbH & Co. in collaboration with Österreichische Studiengesellschaft für Atomenergie Ges. m.b.H. and several Austrian industrial firms are described. (auth)

5602 (IAEA-126, pp 99-114) ULTIMATE DESIGN, EXPERIENCE FROM SMALL DIMENSION MODELS TESTING. Scotto, F. (ENEL, Rome). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

Prestressed concrete pressure vessel models, built and tested for ENEL State Electricity Generating Board by the "Instituto Sperimentale Modelli e Strutture-ISMES" of Bergamo, Italy, within the framework of the EURATOM, THTR Contracts and ENEL research work, are discussed. The behavior of the structure as the pressure increases is outlined starting from working condition up to structural collapse. The "nearly elastic", the "definitely anelastic" and the collapse limits of the structure are discussed with regard to the concrete, the liner and the cable steel behavior. (auth)

5603 (IAEA-126, pp 115-177) COORDINATED WORK PROGRAM FOR PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS IN THE FEDERAL REPUBLIC OF GERMANY. Jaeger, T. A. (Bundesanstalt fuer Materialpruefung, Berlin). 1970.

From panel on basic structural design philosophy criteria and safety of concrete reactor pressure vessels; Vienna, Austria (9 Feb 1970).

An optimum design of a PCPV for gas-cooled or water-cooled power reactor systems can be achieved only if the reactor vessel is not considered as just a construction project, but if it is interpreted as a functional unit incorporated in the specific power reactor system with interrelated functional, safety and economic connections with the system. The concept of a basic program for research and development on prestressed concrete reactor pressure vessels in the Federal Republic of Germany, as well as the basic structural design philosophy, criteria, and safety of PCPV's is discussed. Several special engineering developments for PCPV (e.g. multilayer, prefabricated vessel structures, and prestressing systems) are described. Detailed descriptions of "Joint Development Programs of Prestressed Concrete Pressure Vessels for BWR" (AEG-Telefunken and Fried. Krupp GmbH), "Prestressing System Developments Using Different Methods", "Computational Methods" and "Instrumentation Assessment Program" are given in the appendixes. (auth)

5604 STATUS OF KNOWLEDGE ON STRESS AND DEFORMATION ANALYSIS AT CRITICAL LOCATIONS OF STEEL REACTOR PRESSURE VESSELS. Latzko, D. G. H. (Delft Univ. of Tech., Netherlands); Cloud, R. L. Nucl. Eng. Des.; 26: No. 3, 364-375(1974).

A review is presented of knowledge on stress and deformation analysis at critical locations of steel reactor pressure vessels such as flanges, nozzles, nozzle-to-cylinder connections and nozzle-to-hemisphere connections. Besides elastic stress analysis, the application of linear-elastic fracture mechanics, plastic limit load analysis, stress analysis in the creep range, and the analysis of problems of dynamic loading are treated. 71 references. (auth)

5605 DAMPING VALUES OF NUCLEAR POWER PLANT COMPONENTS. Morrone, A. (Westinghouse Electric Corp., Madison, PA). Nucl. Eng. Des.; 26: No. 3, 343-363(1974). (WCAP-7921).

Damping values and data from various tests of nuclear power plant components and other structures are presented and evaluated. A description of the damping determinations is given along with recommended damping values for nuclear reactor systems primary coolant loop components, piping and other structures. The results show that, in general, damping increases with the magnitude of excitation and the resulting stress levels. It is shown that system damping, which is considered as the predominant damping mechanism for primary coolant loop components, yields damping values higher than those being used. 28 references. (auth)

5606 NATURAL CONVECTION COOLING FOR OFFSHORE NUCLEAR POWER PLANTS. Klystra, C. D. (Univ. of Florida, Gainesville). Nucl. Technol.; 22: No. 2, 191-195(May 1974).

A preliminary evaluation of the use of natural convection cooling to remove waste heat from off-shore nuclear power plants is presented. This approach would minimize the environmental problems of thermal and mechanical shock and excessive temperatures associated with once-through cooling. The results indicate that approximately six times the length of condensate tubing used in a conventional condenser would be needed for natural convection cooling; a more complicated steam-handling system would also be required. The concept could only be justified if a power plant is needed at a particular site where the environmental cost of the conventional system exceeded the cost of natural convection cooling. 3 references. (auth)

5607 USE OF A PSEUDO RANDOM BINARY REACTIVITY INPUT AND THE RESULTING GAMMA RAY FLUCTUATIONS TO DETERMINE THE TRANSFER FUNCTION OF A NUCLEAR REACTOR. Bailey, R. W. Columbus, OH; Ohio State Univ. (1973). 93p. University Microfilms Order No. 74-3112.

Thesis (Ph. D.).

The transfer function of a critical nuclear reactor has been determined by measuring the cross correlation between a Pseudo Random Binary Reactivity Input and the resultant gamma ray fluctuations. Similar measurements were performed using neutron fluctuations and were shown to yield similar results. Measurements using a detector sensitive to both neutrons and gamma rays were also shown to be consistent with the neutron and gamma only determinations. A complete on-line electronic system was designed and assembled as well as a pseudo random reactivity insertion device. (Diss. Abstr. Int., B)

5608 PROBLEMS OF HEAT DISSIPATION IN LARGE CONDENSATION BLOCK UNITS. Schueller, K. H. (Brown, Boveri und Cie A.G., Mannheim, Ger.). Atomwirt., Atomtech.; 19: No. 2, 87-91(Feb 1974). (In German).

The heat dissipation within large condensation block units is a technical as well as an economical problem and a question of environmental protection. Since nuclear power plants will take over an important part of the energy supply in future, the problems of heat dissipation in large condensation block units are first of all problems of the planners of nuclear power plants. From the planners' aspect it would be necessary to clear up some questions which have not yet been solved satisfactorily, such as feasibility of cooling tower for large units as concrete, steel skeleton or cable net stressed-skin construction in circle and other possible designs, questions of applicability and economics of plastic heat exchangers in dry cooling towers, the realistic determination of economical aims and thus to treat the cold block end as a connected balance system. (GE)

5609 OPERATIONAL SAFETY OF REACTOR PRESSURE VESSELS. Existing Safety Measures Against Pressure Vessel Rupture. Dorner, H. (Kraftwerk Union AG, Erlangen, Ger.). Atomwirt., Atomtech.; 19: No. 3, 120-125(Mar 1974). (In German).

In the present contribution it is shown that for redundant securing against pressure vessel rupture, the measures met of construction, calculation, choice of material, fabrication and fabrication control together with pressure sample and repeated tests are completely adequate. (GE)

5610 CLEAN-UP RECIRCULATION PUMPS AND LOOP TESTS AT HIGH TEMPERATURES AND PRESSURES. Machida, A. (Ebara Manufacturing Co. Ltd., Tokyo). Ebara Jiho; No. 86, 10-15(Dec 1973). (In Japanese).

A loop testing set and a series of loop tests for the clean-up recirculation pump are described. The testing device can vary pumped fluid temperatures in a range of a room temperature to 285°C, and pump suction pressure from 1 kg/cm^{2}G to 84 kg/cm^{2}G.

The specifications of the clean-up recirculation pump, the records of its performance in the field and the loop testing device are outlined. (auth)

5611 RESONANT ACOUSTIC NOISE SPECTRA OF NUCLEATE COOLANT BOILING. Nishihara, H. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 11: No. 1, 1-7(Jan 1974).

The detection of anomalous coolant boiling in non-boiling reactors is an important problem for assuring reactor safety. Acoustic techniques are an effective means of such detection. Reliable detection of boiling postulates frequency spectra peculiar to boiling, and if, moreover, the location of the boiling sites is to be determined, it should further be necessary to distinguish noise emanating directly from the point of boiling. The method described is to find out experimentally whether the often observed resonance-like peaks of boiling noise are associated with the actual collapsing of bubbles or due to the resonances of the container system. Localized nucleate boiling was generated by electric heater immersed in a water tank. Two hydrophones were suspended in the water at different distances from the heater and the acoustic signals detected therewith. The signals thus gathered were conditioned and processed in cross-correlation functions. Results are presented. (auth)

5612 VALVE MALFUNCTIONS IN NUCLEAR POWER PLANTS. Nucl. Safety; 15: No. 3, 316-320(1974).

The results are presented of three independent surveys of data describing malfunctions of valves used in reactor facilities during three separate but overlapping time intervals and a fourth survey of experience concerning the structural integrity of valves. None of the valve problems covered by the reviews have posed a threat to the health and safety of the off-site public. However, in a few cases, valve malfunctions have led to nonradiological injuries to plant personnel. The apparent rates of malfunction of valves ranged from 2.5 to 8.1 per plant per year, although the higher number is believed biased by a large amount of preoperational test data. The fourth survey indicated that 15% of the valves did not meet wall-thickness specifications. (auth)

5613 ANS STANDARD N18.8 ON DESIGN BASES FOR PROTECTIVE SYSTEMS. Ferguson, R. L. Nucl. Safety; 15: No. 3, 292-294(1974).

The Standards Committee of the American Nuclear Society has developed criteria related to establishing the design bases for the integrated response of the actuator systems, the protection systems, and their supporting systems to the postulated accidental events that might occur during the life of nuclear power stations. These criteria represent the first attempt to develop criteria for the integrated response of the several systems that protect the station and the public. 3 references. (auth)

Reactor Fuels

Refer also to abstracts 2850–2852, 2859, 3767, 3770, 3773, 3774, 3776, 3788, 3801, 3804, 3814, 4003, 4015, 5397, 5399–5401, 5428, 5455, and 5687.

5614 (JAERI-M-5410) TECHNICAL STATUS OF THE LINEAR HEAT RATING ESTIMATION WITH JMTRC CRITICAL FACILITY. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 87p. (In Japanese). NTIS (US Sales Only).

The linear heat ratings (W/cm) of fissionable specimens in the Japan Materials Testing Reactor (JMTR) are estimated by two approaches; one is experimental with the critical facility JMTRC, and the other is calculational. The experimental approach is first reviewed including the technical status of the JMTR No. 14 operation cycle. Accuracies of the experimental approach (Q_{cr}) are then discussed in comparison with the calculational (Q_{cal}) for cycles No. 3 to No. 14 of the operation. (auth)

5615 INFLUENCE OF PELLET LENGTH ON INTERACTION BETWEEN FUEL AND CLADDING IN SIMULATED REACTOR FUEL PINS. Whatham, J. F. (Australian Atomic Energy Commission, Lucas Heights). Nucl. Eng. Des.; 26: No. 3, 423-431 (1974).

An electrically heated fuel pin test apparatus has been developed for out-of-pile investigations of fuel pin parameters with a view to supplementing in-pile experiments. Sixty per cent of reactor heat ratings has been achieved with a hollow pin having an axially located electrical heater, the limitation being the melting of the UO_2 pellets. The theoretical unconstrained shapes of a heated pellet and a fuel pellet under elastic conditions were calculated. Both showed an "hour glass" form suggesting that permanent circumferential ridges would occur in the cladding of a heated pin as they do in the cladding of fuel pins. These ridges were subsequently produced in heated pins, the pins being heated while immersed in cooling water at typical reactor temperatures and pressures. From a series of such tests using different pellet lengths it was found that a significant reduction in ridge height occurred when the pellet L/D ratio was one-third of the value in a typical reactor. The temperatures reached in the UO_2 pellets were estimated from a metallographic examination of a pin cross section after test. Using published data of $\int k dT$ for UO_2 over various temperature ranges the pin heat output at that cross section was determined. 8 references. (auth)

5616 NUCLEAR REACTOR COMPONENT PART. Gregorius, K.; Peehs, M. (to Siemens AG). German(FRG) Patent 2,149,078. 5 Apr 1973. 7p. (In German).

The patent claims concern a component consisting of an all-round cladding and a filling compound of oxide fission or breeder material, and contains within the cladding, a getter to render the oxygen rising from burnup of the nuclear fuel harmless. The setting up of the getter is described. (GE)

5617 NUCLEAR REACTOR FUEL ROD. Kammerer, P.; Schoeneich, H.; Janner, K. (to Siemens AG). German(FRG) Patent 2,152,132. 26 Apr 1973. 11p. (In German).

A fuel rod or moderator rod is described with a cross section which deviates from the usual circular form, which enables the biggest possible packing density in the reactor core. The expansion room for the rod filling and for the fission gases is arranged in such a way that seen from the circumferential direction, the cladding tube lies alternately on the rod filling or forms a hollow. Four cross sections are proposed which are limited by circle resembling curves. (GE)

5618 NUCLEAR REACTOR FUEL ROD. Gregorius, K.; Peehs, M. (to Siemens AG). German(FRG) Patent 2,145,671. 22 Mar 1973. 9p. (In German).

A fuel rod is described containing solid, preferably ceramic fission or breeder material in a cladding tube, and is arranged in a coolant channel with symmetrically different radial cross sections. The fuel rod is built inside in such a manner that radial sectors of the coolant channel with smaller cross section are opposite radial areas of the fuel rod with smaller heat conductivity, and vice versa, coolant channel sectors with large cross section are opposite radial areas of the fuel rods with normal or higher heat conductivity. (GE)

5619 NUCLEAR REACTOR FUEL ROD. Gregorius, K. (to Siemens AG). German(FRG) Patent 2,155,518. 17 May 1973. 7p. (In German)

The described fuel rod consists of a cladding tube closed at both sides and a pellet shaped fuel leaving a ring shaped gap to the cladding. The nuclear fuel which has a tendency to swell is connected to the cladding tube by a porous, preferably hydrogen-proof glass flow. The patent deals with pores content, viscosity and component parts of the glass flow. (GE)

5620 FUEL ELEMENT AND/OR BREEDER ELEMENT FOR NUCLEAR REACTORS. Boettcher, A. (to Gelsenberg AG). German(FRG) Patent 2,200,373. 12 Jul 1973. 8p. (In German).

The described fuel contains in the metallic cladding besides the fuel or breeder material, a material to improve the heat transfer, which is liquid at the operational temperatures of the cladding. The non-irradiated fuel or breeder material contains in the half of the volume close to the axis continuous hollows in the direction of the axis, which contain at least 10% of the medium fed in, to transfer heat to the element. The fuel or breeder material has the shape of spherical particles or hollow pellets. (GE)

Reactor Control Systems

5621 (CONF-740608-5) LMFBR CONTROL RODS SCRAM DYNAMICS. Carelli, M. D.; Brandt, H. W.; Bach, C. W.; Kulikowski, H. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(45-1)-2171. 5p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

The testing of FFTF control assembly models is described and the results are compared with predicted LMFBR scram dynamics. (JWR)

5622 (EGU-5120209) DESIGN OF AN AUTOMATED TECHNOLOGICAL UNIT FOR VVER-TYPE NUCLEAR POWER PLANT. Borsky, M.; Kurka, J.; Pechac, M.; Kuklik, B.; Ochotny, P. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)). 1973. 74p. (In Czech). INIS.

An analysis is made of a nuclear power plant of the VVER-type from the point of view of automation and a breakdown of the power plant into functional groups is presented. Two designs of air pump automatic control systems are described in detail. Also outlined

are two programs, namely the MIVO program for minimalization of logical expressions, and a program for the decomposition of the logical function. (INIS)

5623 (JAERI-M-5361) ANALYSIS OF CONTROL ROD WORTHS IN THE NSRR. Reactor Physics and Nuclear Design of the Nuclear Safety Research Reactor, 3. Ise, T.; Nakahara, Y. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 48p. (In Japanese). NTIS (US Sales Only).

The calculational method and the results of analysis of control rod worths for the NSRR (Nuclear Safety Research Reactor) are presented. The characteristic feature of the reactor structure lies in the presence of a big experimental hole at the center of the compact annular core. As a result of this, the present calculation has given the following conclusions on the control rod effects: the interference among control rods gives a non-negligible positive effect to the worth, even when only 3 transient rods are inserted in the core; the control rod worths and the neutron flux distributions in the core are affected by the neutron leakage through the experimental hole; the control rod worths depend on a material in the experimental hole; and the convergence achieved through the iteration in the diffusion calculation becomes poor as the arrangement of the control rods becomes asymmetric. (JA)

5624 (KURRI-TR-109) REPORTS OF THE 2ND STUDY MEETING ON COMPUTER CONTROL OF NUCLEAR REACTOR. Fujine, S.; Kanda, K. (Eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1973. 176p. (In Japanese).

Separate abstracts are included for each of the 20 technical papers presented concerning the use of computers for nuclear reactor control systems. (DCC)

For abstracts of individual papers see: 3050, 5475, and 5625–5642.

5625 (KURRI-TR-109, pp 10-13) COMPUTER CONTROL SYSTEM DEVELOPMENT AT THE OECD HALDEN REACTOR PROJECT. Sato, K. 1973. (In Japanese).

An extensive development of the computer control systems for nuclear reactor plants has been carried out at the OECD Halden Reactor Project since 1967. The activities of the Project, the computer facilities, and the principal results obtained so far are reviewed. The future plan of the development works is discussed. (auth)

5626 (KURRI-TR-109, pp 14-20) STATUS OF THE USE OF COMPUTERS IN OPERATION OF NUCLEAR POWER PLANTS IN EUROPE. Wajima, T. (Hitachi, Ltd., Kawasaki, Japan). 1973. (In Japanese).

Topics discussed at "the Specialists' Meeting on Experiences in the Use of Computers in the Operation of Nuclear Power Plants" were reported. The meeting was held at Brussels in October 1971 under the auspices of International Atomic Energy Agency and European Community. The report includes: West Germany's program for the development of a computerized safety system; problems encountered by software programs in the course of their development and application to the control of nuclear power plants; data on availability of computers at various facilities; experiences in the use of hardware and their failure data; and evaluation from the operation management view of the introduction of computer systems into the control of nuclear power plants. (auth)

5627 (KURRI-TR-109, pp 21-23) OUTLOOK OF POWER DISTRIBUTION CONTROL. Suda, N. (Osaka Univ.). 1973. (In Japanese).

Various approaches to the reactor power distribution control are briefly reviewed. Some possible improvements to the existing approaches are also discussed. It is emphasized that the fuel failure problem should be included in the optimizing criterion of the power distribution control. 9 references. (auth)

5628 (KURRI-TR-109, pp 24-33) NEW INTERFACE OF CONTROL SYSTEM WITH A MINICOMPUTER. Murata, Y. (Musashi Inst. of Tech., Kawasaki, Japan). 1973. (In Japanese).

A new interface of control system with a mini-computer was developed. The I/0 functions have consolidated by a setting up the interface on an extended memory-BUS line of a small computer instead of a conventional I/0-BUS line. This interface consists of such basic constitutions as; processing of read out informations of extended memory, generation of control signals by write-informations of extended memory, and reception of information from external devices and processing of interruptions. This interface has such noticeable effects as speeding up of processing, simplification of software and hardware, removal of restrictions of number of devices, number of instructions, and number of levels and causes of interruption. And this interface can solve the fundamental problems concerned with software and hardware on interface of computer control system. (auth)

5629 (KURRI-TR-109, pp 34-42) HARDWARE SYSTEMS OF THE CONTROL COMPUTER. Kawaskai, J. (Hitachi, Ltd., Kokubunji, Japan). 1973. (In Japanese).

Trends of the control computer systems and their features are reported. In computer controls high reliabilities, hard real time response and system expandabilities are predominate and necessary features. From these points of view, especially from the reliabilities, two-processor systems—dual, duplex and load sharing—and multiprocessor systems are investigated. As an actual system HIDIC-700 system, a new control computer, is reported. This system is featured by software—operating system—on a flexible hardware system which consists of one of the seven kinds of the standard two-processor system. They are standard duplex system, full dual system, load sharing system and mixed types of these three systems—extended duplex system, load sharing duplex system, partial dual system and simple dual system. Also the features of these operating systems are reported. (auth)

5630 (KURRI-TR-109, pp 43-53) CURRENT SOFTWARE IN THE INDUSTRIAL COMPUTER. Matsumoto, Y. (Tokyo Shibaura Electric Co., Ltd.). 1973. (In Japanese).

Technical comments on the current industrial software are presented. The difference of the real-time capability between the process computer system and the general purpose on-line system is discussed. The current tendency on the language development in the industrial applications, and standardizing efforts in ANSI and Purdue workshops are reviewed. Explanations for the on-line language processor and testing software packages are presented. (auth)

5631 (KURRI-TR-109, pp 54-60) RELIABILITY OF COMPUTER CONTROL SYSTEM. Takamatsu, S.; Nakanishi, S. (Tokyo Shibaura Electric Co.). 1973. (In Japanese).

There are three basic approaches improving the reliability of computer control system. First approach is to improve the reliability of hardware itself, second one is based on redundancy, and third one is to make up the software system which is able to perform the necessary processing in spite of some localized faults. The third approach is described. The simple example of software system is presented which detects the technical faults of central processing unit, magnetic core memory, and peripheral devices, and in spite of those faults performs the necessary processing. In this example, the internal redundancy of single computer system is used as much as possible. The quantitative estimation of on-line test program is discussed. For this the machine logic simulator for process control computer Tosbac-7000 model 20 is designed. It proves to be a very useful tool for the investigation of faulty computer behavior. (auth)

5632 (KURRI-TR-109, pp 61-96) STUDY ON COMPUTER CONTROL FOR REACTOR WITH KYOTO UNIVERSITY RESEARCH REACTOR. Kanda, K.; Fujine, S.; Hayashi, M.; Nakamura, H.; Ishihara, S. (Kyoto Univ.). 1973. (In Japanese).

On the computer control for nuclear reactors the fundamental study has been performed with Kyoto University Reactor (KUR) in combination with a minicomputer system (OKITAC-4300S). The following items are described: process input/output (P I/0) interface; development of software for the present system; problems in connecting the system with existing instrumentation of KUR; interrupt signal analysis; automatic calibration of control rod worth; xenon poisoning in operation and xenon override; and neutron flux distribution measured by incore chambers. The possibility of introducing a parallel processing multi-minicomputer (PPM) system is discussed. (auth)

5633 (KURRI-TR-109, pp 97-101) COMPUTER CONTROL EXPERIMENTS ON JPDR. Osanai, M. (Japan Atomic Energy Research Inst., Tokai). 1973. (In Japanese).

A joint R&D project on computer control of nuclear power plants started mid last year between Japan Atomic Energy Research Institute (JAERI) and Hitachi, Ltd. A HIDIC-500 process computer system is to be installed at the site of the Japan Power Demonstration Reactor (JPDR), JAERI, the only experimental power reactor now in Japan. The programme is aimed at demonstrating the feasibility of techniques necessary for automatic operation of nuclear power plants. Improved operational reliability and reduced probability for hazardous situations during plant operation are expected. Monitoring of the core performance with the predicting function and of the sequence of the plant operation, combined with a colour CRT system, will yield valuable data for improved scheduling and execution of operation and flexible man-machine communication system. An incipient failure diagnosis system as well as alarm analysis is planned to improve reliability through quicker response of operational and maintenance staff. Sequence control, load follow control and fuel management systems are also scheduled. (auth)

5634 (KURRI-TR-109, pp 102-108) COMPUTER APPLICATION FOR THE JMTR OPERATION. Kondo, I. (Japan Atomic Energy Research Inst., Oarai). 1973. (In Japanese).

A computer control has not been used for the JMTR operation yet, but some trials are being carried out. At JMTR it is difficult to control power distribution in the fuel region or flux values at irradiation experiments finely in operation, then it becomes important how to arrange the core configuration before operation. To do that, data obtained from the foregoing operation must be used efficiently, so the data logging is important. When the computer control is considered for JMTR, an abnormality monitoring may form a part of that. Two methods—reactivity balance and noise analysis—are considered how they can be included in the JMTR computer control. (auth)

5635 (KURRI-TR-109, pp 109-118) EXPERIENCES IN THE USE OF AN ON-LINE COMPUTER IN TSURUGA PLANT (BWR). Yamaguchi, K. (Japan Atomic Power Co., Tsuruga, Fukui). 1973. (In Japanese).

The on-line computer at the Japan Atomic Power Company's Tsuruga Plant is in its second year of operation. The installation of the computer hardware was begun in February of 1969 with repeated adjustment of the hardware, program loading and debugging. The computer system completed the synthetic test in December 1970 and began its role as a 24 hour plant monitor system. After the test, the computer worked pretty good for about one year but the availability of the computer was about 80% excluding hardware failure and software trouble. During this period, many experiences and various improvements were made. The computer has been working very well this year. (auth)

5636 (KURRI-TR-109, pp 131-139) PROCESS DEVICE FOR COMPUTER CONTROLLING. Ito, H. 1973. (In Japanese).

In process control, computers may be generally used in two ways: Supervisory Computer Control (=SCC) and Direct Digital Control (=DDC). Information on the two types of computer control systems is presented. (auth)

5637 (KURRI-TR-109, pp 140-144) OKI'S APPROACH TOWARD COMPUTER CONTROL OF THE REACTOR. Itaya, S. 1973. (In Japanese).

Coupled with higher reliability with less price of mini-computer as system components, it is a trend to divide the system in terms of function and reorganize it as the multi-computer system with the employment of mini-computers. OKI ELECTRIC has prepared OKITAC-4300 and OKITAC-4500 system to meet precisely such a requirement and performed various applications in the field of process measuring control. Experimental System was prepared for Measuring Control of Reactor but is the ON LINE OPEN LOOP. Computer control of CLOSED LOOP is required for research reactor KUR-2 to meet more complicated operation and a series of fundamental experiments therefor is now in process. Establishment of Algorithm and interfacing method are the outcomes attained in such experiments, however, computer control equipment must further be provided with the function of high speed operation suitable for control of reactor and with high reliability, too. (auth)

5638 (KURRI-TR-109, pp 145-150) COMPUTER CONTROL OF NUCLEAR POWER PLANTS FROM A LONG TERM VIEWPOINT. Monta, K. (Nippon Atomic Industry Group Co., Ltd., Tokyo). 1973. (In Japanese).

The computer control of nuclear power plants was considered from a long term viewpoint. There exists a need for full automation of nuclear power plants, and for this need the computer control technology is essential and should be developed. (auth)

5639 (KURRI-TR-109, pp 151-154) DEVELOPMENTS ON THE APPLICATION OF ON-LINE COMPUTERS TO NUCLEAR PLANTS IN HITACHI. Takumi, K. 1973. (In Japanese).

Developmental works at Hitachi Ltd. in progress, are described, which come from new needs in nuclear plants compared with the fossil fueled steam plants. For the core performance calculation for BWR, "BWR plant core performance calculation simulation system" was developed and moreover systems for commercial nuclear plants were developed. For the purpose of system debugging, off-line simulation system was developed at the same time and this system was checked by the data of BWR plants in power. The on-line system for nuclear plants must be large, so that the system must have hierarchical structure basically. Minicomputers, medium size computers and large scale computers were developed for the hierarchical control system. As an example of man-machine communication interface, colored CRT display equipment and application software for nuclear power plant are described. 5 references. (auth)

5640 (KURRI-TR-109, pp 155-159) MINICOMPUTER AND NUCLEAR PLANTS. Akagi, M. 1973. (In Japanese).

Specifications of NMC NOVA minicomputers are described considering their application to nuclear plants. Input/Output features, programmed I/0, program interrupt and direct memory access are described. Multi processor system is also described in detail. (auth)

5641 (KURRI-TR-109, pp 160-165) COMPUTER CONTROL OF AGR NUCLEAR POWER PLANT. Ogushi, K. (Fuji Electric Co. Ltd., Tokyo). 1973. (In Japanese).

The characteristics of the computer control system for AGR nuclear power plant are described in contrast with the usual water power reactors. According to the case of Dungeness "B", the features of AGR control are described in detail. (auth)

5642 (KURRI-TR-109, pp 166-172) COMPUTER APPLICATION TO NUCLEAR POWER PLANT. Odahashi, M. (Mitsubishi Electric Corp., Tokyo). 1973. (In Japanese).

As an example of the application of computer control to the nuclear power generation, description is presented of a computer system applied to the power plant and to the computer software function. The computer system application to the PWR power plant is realized as the step of data logger use in the case of the thermal power plant. But the computer functions have so highly advanced already that not only complicated performance calculation but operation guide informations with sophisticated fuel calculation of nuclear power generating equipment are carried on. (auth)

5643 (N-74-14442) NUCLEAR ELECTRIC PROPULSION REACTOR CONTROL SYSTEMS STATUS. Ferg, D. A. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 15 Dec 1973. 30p. (NASA-CR-136471; JPL-TR-32-1585). NTIS $3.50.

The thermionic reactor control system design studies conducted over the past several years for a nuclear electric propulsion system are described and summarized. The relevant reactor control system studies are discussed in qualitative terms, pointing out the significant advantages and disadvantages including the impact that the various control systems would have on the nuclear electric propulsion system design. A recommendation for the reference control system is made, and a program for future work leading to an engineering model is described. (auth) (STAR)

5644 (UTIA-416) ALGORITHMS FOR COMPUTER SAFETY SYSTEM OF NUCLEAR REACTOR. Kovanic, P.; Thoma, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Teorie Informace a Automatizace). Nov 1972. 74p. (In Czech). INIS.

Computer algorithms were evaluated for a nuclear reactor safety and control system; a suitable class of estimation procedures was selected; the dependence was evaluated of the estimation errors on a priori information; a number of practical formulas for optimum estimations is listed and their accuracy given; and the applicability was evaluated of simple estimators in decision-making algorithms of the safety and control system. For a practical application, the estimation process can preferably be implemented in four stages of various complexity. The application can be recommended of constant estimators with finite memory which use the information on mean values and covariances and decision-making algorithms, simplified to a maximum, both for the ascertainment of emergencies and for their identification. The simplification can best be achieved by the suppression of random disturbance effects as a result of the application of optimum estimators prior to decision-making. (auth)

5645 SIMULATION STUDIES OF A PRACTICAL REACTOR CONTROL SYSTEM PROVIDING TIME-OPTIMAL SHUTDOWN. Corran, E. (Australian Atomic Energy Commission, Sutherland); Stapleton, C. A. Nucl. Sci. Eng.; 54: No. 1, 47-54(May 1974).

A control system is described which will shut down a reactor in close to the minimum time that will allow subsequent restart on demand, despite fission product buildup. Errors in the reactor model, restrictions on operating conditions, and plant perturbations are taken into account. The system uses an on-line computer, requires no extra reactor instrumentation, and provides the operator at all times with an estimate of the minimum time to transfer the reactor from its current state to a suitable shutdown condition. During normal operating conditions, the operator may use the system to evaluate strategies satisfying various restart conditions. The results of simulation tests on the system are included. (auth)

5646 DYNAMIC PROGRAMING APPROACH TO SPATIAL CONTROL OF LARGE CANDU TYPE REACTORS. Purandare, H. D.; Lawande, S. V. (Bhabha Atomic Research Centre, Bombay). pp vp of Symposium on Nuclear Science and Engineering. Bombay; Bhabha Atomic Research Centre (1973).

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

In large reactor systems, there is a general tendency towards a neutronic decoupling of various regions of the reactor. This creates the problem of spatial control which may conveniently

be handled by dynamic programming methods. A dynamic programming approach for the spatial control problems of large CANDU-type reactors is discussed. This approach provides a convenient procedure for optimizing the sequence of central rod movements in various regions of the reactor to restore equilibrium flux distribution after a flux deviation in any one of the regions. (auth)

5647 STUDY OF NUCLEAR POWER SYSTEM DYNAMICS USING A PSEUDO-RANDOM BINARY INPUT. Warren, L. D.; Ivanjack, W. F.; Saxe, R. F. (North Carolina State Univ., Raleigh). Ann. Nucl. Sci. Eng.; 1: No. 1, 49-53(Jan 1974).

The feasibility of various methods of applying a pseudo-random binary input to the control rods of a power reactor system was investigated and three automatic methods were devised. Experiments were conducted using a manually-applied pseudo-random binary input and the reactivity transfer functions of neutron density, reactor pressure and primary coolant flow were derived. The results are shown to be consistent with calculations based on known parameter values. The method is shown to be feasible and enables dynamic behavior to be determined with negligible disturbance to the system output. (auth)

Nuclear Power Plant Economics

Refer also to abstracts 5382, 5449, 5541–5544, and 5705.

5648 (CONF-730979-, pp 47-76) ROLE OF FULLY DEVELOPED NUCLEAR ENERGY IN THE NEXT DECADE. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The present status of nuclear energy is briefly outlined, and the objections to nuclear energy are reviewed. Each of these objections is analyzed and rebuttals are made. The importance of nuclear energy in meeting the energy requirements of the world is indicated. (JSR)

5649 (CONF-740501-, pp 92-114) COMPARATIVE POWER PLANT SELECTION CRITERIA. Olver, D. J.; MacNabb, W. V. 1974.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (7 May 1974).

In gas-cooled reactors: HTGR and GCFBR.

The process of selecting between a High Temperature Gas-Cooled Reactor nuclear steam system and a Light Water Reactor nuclear steam supply system for a central station electricity generating power plant is divided into an economic evaluation of the entire plant and fuel, a technical evaluation of plant structures, systems, components and fuel, and an analysis of commercial considerations. Items of significant difference in each category are described, and expected trends are identified. Much of the evaluation can be expressed in economic terms, but many aspects are subjective, their importance to the evaluation being dependent on the characteristics of the particular case, and the evaluators' judgement as to their relative significance to the utility. (auth)

5650 (CONF-740608-4) APPLICATION OF MID-RANGE PLANNING METHODS TO NUCLEAR SYSTEMS. Bennett, L. L.; Farrar, D. L. (Oak Ridge National Lab., Tenn. (USA); Commonwealth Edison Co., Chicago, Ill. (USA)). 1974. 6p. Dep. NTIS $4.00.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

The power and flexibility of a simulation model for use in developing utility operating strategies, particularly as related to nuclear unit scheduling is illustrated. (JWR)

5651 (DEU-73-14) CONSEQUENCES FOR THE POWER PLANT PROJECT FROM THE COST DEVELOPMENT IN POWER PLANT CONSTRUCTION AND OPERATION, TAKING THE RESULTING IMPACTS ON THE ELECTRIC POWER SUPPLY IN ACCOUNT. Krieb, K. H.; Frenzel, P.; Vogel, J. (Comps.). (Steinkohlen-Elektrizitaet A. G. (STEAG), Essen (F. R. Germany)). 1973. 37p. (In German). INIS.

Following a survey on the present structure of the thermal electricity generation plants in the FRG, the development of the power plant costs (labour costs, investment costs, operation costs and fuel use costs) in the past years has been investigated. From the cost investigations of power plants and power plant blocks of various capacities and of the effects of the increase in costs of electricity generation over the past years, proposals for future optimum capacities of power plants and power plant blocks have been made. (GE)

5652 NEW WAYS OF FUTURE SECURING OF RAW MATERIALS BY APPLYING NUCLEAR ENERGY. Merz, E.; Propiesch, P.; Zimmer, E. (Kernforschungsanlage, Juelich, Ger.). Chem.-Ing.-Tech.; 46: No. 1, 19-22(Jan 1974). (In German).

From 24th IUPAC congress; Hamburg, Ger. (2 Sep 1973).

Increasing world demand for non-ferrous metals and exhaustion of many terrestrial deposits in coming decades will necessitate exploitation of the gigantic ore reserves occurring as marine sludges and manganese nodules. The unfavorable composition of these ores makes the energy costs for recovery and beneficiation of prime importance. Use of relatively inexpensive nuclear power holds promise of cost reductions. Assuming that transport of the entire ore to land-based facilities will be uneconomical, a proposal to provide electrical energy and process steam for dressing and chemical separation steps by a nuclear reactor installed in a ship or on a processing platform is made. The basic chemicals required would be accessible from the sedimentary sludges themselves or from seawater. The marine ecology will not be significantly affected. Examples are given to illustrate the possibility of combined operations. (GE)

5653 ROLE OF THE MODEL IN PLANNING POWER STATIONS. Quaiser, W. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Brown Boveri Rev.; 60: No. 9, 398-403(Sep 1973).

Planning thermal power stations involves coordinating the ideas, experience and actions of a large number of engineers, specialists and firms towards a common goal. Cooperation does not depend on organization alone. Important factors include the structure of the documentation necessary for mutual understanding and the presentation of the layouts used at the project planning stage. The model has recently become an invaluable aid for certain planning tasks. Its three-dimensional configuration lends unequaled clarity which is a definite aid in combining the various components to form an optimum entity. (auth)

5654 NUCLEAR POWER FOR VANCOUVER ISLAND. Ottawa; Atomic Energy of Canada Ltd. [nd]. 37p. $1.00.

Vancouver Island appears to be a logical area for the application of nuclear power. The cost of power from a nuclear plant on the Island would be less than that from any of the alternatives understood to be currently under consideration; inflation of the costs of conventional fuel will increase the differential during the life of the plant. The effects on the environment would be less than for any alternative source of power. A nuclear power unit of up to 600 MW (600,000 kilowatts) would fit in with existing power sources on the Island. Existing hydro plants and undersea cables to the mainland would help to even the load on the nuclear plant, and provide power when it was necessary to shut down the nuclear plant for maintenance. (auth)

5655 IMPLEMENTATION AND MANAGEMENT OF NUCLEAR PROJECTS: U. S. EXPERIENCE. Brush, H. (Bechtel Corp., San Francisco). pp 361-367 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some comments are presented on the major ways that nuclear power projects are implemented in the United States. There are three basic approaches to nuclear power plant construction. The first is the so-called "turnkey" approach. Two other ways of doing the same job, ways that are more traditional for United States utilities, are (1) the utility uses its own forces for design and construction, simply buying the equipment from the suppliers, and (2) the utility goes to an independent architect-engineering-construction company, and hires them to do the management and the technical work of engineering and constructing the plant. (INIS)

5656 INDUSTRIAL PARTICIPATION IN A NUCLEAR POWER PROGRAM. Karger, J. P. (International Atomic Energy Agency, Vienna). pp 557-562 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Methods of involving local industry in a nuclear power program are discussed. The cases presented indicate that different countries have used different techniques. In all cases the conclusions are however, that (a) a conscious effort must be made to develop industry for participation in nuclear power projects, (b) the effort will involve expenditure of time and money, (c) the expenditure to build up the industry can only be justified if an adequate market and heavy component manufacturing industry exist, (d) advance planning efficiently executed will result in maximum training of industry at minimum costs, (e) different countries will find varying specific techniques most suitable for their needs. (INIS)

5657 ECONOMIC PROSPERITY AND NUCLEAR POWER. Brooks, L. G. (United Kingdom Atomic Energy Authority, London). Ann. Nucl. Sci. Eng.; 1: No. 1, 3-9(Jan 1974).

The part that energy has played in the economy, the link be-

tween energy consumption and living standards, and the relation between energy and economic output are discussed. The world demand for, and supply of, energy are considered and ways of reconciling the two are examined. It is concluded that there need be no energy crisis in the longer term. Nuclear power must play a bigger role, portable fuels being confined to applications where portability is essential. In the U. K., North Sea oil and gas should be valued at the world price and should be regarded primarily as a source of relief to the balance of payments difficulties relieving some of the "stop-go" interruptions to economic progress. (UK)

5658 PROJECT MANAGEMENT. Dahlinger, A. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). pp 349-360 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Project management should be involved early in a project. The ideal stage to begin is prior to the invitation to tender. This involvement continues through the preparation of the proposal and negotiations leading to the award of contract. With this early involvement, the successful execution of the project is more assured. The successful execution of the project is most dependent upon project management building up good team spirit and the "proper" attitude towards safety, reliability, schedules and costs. There is no lack of techniques in planning, scheduling, and cost control. There may be a lack of desire and self-discipline. (INIS)

5659 BID EVALUATION: SOME CONSIDERATIONS FOR DEVELOPING COUNTRIES. Karger, J. P.; Chase, D. B. (International Atomic Energy Agency, Vienna). pp 563-571 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The complex subject of bid documents preparation or of bid evaluation is not discussed. The analysis techniques have not been mentioned. The principles are well known and the techniques of application are becoming better known and can be learned from a number of large utilities or from some consultants. The developing countries have however specific additional problems to consider which differ from the ones encountered in the USA and Europe and these subjects are described. (INIS)

5660 GUARANTEES AND WARRANTIES OF NUCLEAR POWER PLANTS. Imai, R. (Japan Atomic Power Co., Tokyo). pp 417-422 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some of the practical problems with regard to guarantees and warranties are described. Many of them are common in their basic nature with construction and operation of any power plants. There are considerable differences that come from the fact that one is talking about nuclear power stations. The example of the Tsuruga plant is presented. The problem of guarantees and warranties are an intrinsic part of the nuclear power plant game. (INIS)

5661 ASPECTS OF TURNKEY CONTRACTS VERSUS OTHER ALTERNATIVES. Polliart, A. J. (CEN de Saclay, Gif-sur-Yvette, France). pp 547-555 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

An overall comparison is presented for both turn-key contracts and other alternatives. (INIS)

5662 IMPLEMENTATION AND MANAGEMENT OF NUCLEAR PROJECTS: GERMAN EXPERIENCE. Hetz, L. (Kraftwerk Union AG, Erlangen, Ger.). pp 307-330 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

A report is presented on the development and the construction of German nuclear power stations. Information is presented concerning the kinds of power reactors being built in the German Federal Republic, specifications for these power reactors, and contract arrangements for the construction of the reactors. (INIS)

Reactor Fuel Cycle Economics

Refer also to abstracts 5396 and 5705.

5663 NUCLEAR FUEL MANAGEMENT FOR NUCLEAR POWER PROJECTS. McLeod, N. B. pp 369-386 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The purposes of this paper are: to describe how utilities organize and schedule the activities necessary for the practice of cost-effective nuclear fuel management, and to relate relevant experience to date, and point out the areas where greater emphasis or change is indicated. The timing of the various policy questions and activities involved in the practice of Nuclear Fuel Management (NFM) is discussed. (INIS)

Reactor Licensing and Regulation

Refer also to abstracts 5366, 5373, 5538, and 5679.

5664 (CONF-730979-, pp 161-183) LICENSING OF NUCLEAR POWER REACTORS IN THE UNITED STATES: NEW DEVELOPMENTS. Shapar, H. K. (Atomic Energy Commission, Washington, DC). Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The new developments discussed include the US AEC's policy of encouraging standardization of nuclear power plants in regard to the regulatory approach to the licensing of barge-mounted reactors that will be operated in an ocean environment; the conduct of rule making hearings in connection with the issuance of AEC regulations; some current ideas that have surfaced in connection with the possible extension and revision of nuclear hazard indemnification legislation in the US; and a legislative proposal that would separate the developmental functions of the AEC from its licensing and related regulatory functions. (MCW)

5665 (CONF-730979-, pp 185-193) LICENSING CRITERIA OF THE COOLING PROCESSES ADOPTED IN NUCLEAR POWER STATIONS. Pfister, W. (Eidgenoessischen Amtes fuer Energiewirtschaft, Bern). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

Some problems connected domestically and internationally with the thermal pollution of water by nuclear power plants are discussed. The effects of cooling towers on the environment in the Swiss situation are briefly evaluated. (JSR)

5666 (CONF-730979-, pp 195-211) LICENSING NUCLEAR POWER STATIONS NEAR NATIONAL BORDERS. Moser, B. Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The special problems posed in the licensing of nuclear power plants near national borders are discussed. The factors in normal operation and catastrophic conditions that may affect a neighboring country are outlined. The precautions that must be taken are summarized. (JSR)

5667 (CONF-730979-, pp 213-227) HARMONIZATION THROUGH INTERNATIONAL TECHNICAL STANDARDIZATION. Franzen, L. F.; Matting, A. (Institut fuer Reaktorsicherheit, Cologne). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The concept of standardization is defined and its desirability is illustrated. International developments in attaining this goal are summarized. International organizations concerned with standardization of liability and their purposes are tabulated. Present international regulations are briefly discussed. 60 references. (JSR)

5668 (CONF-730979-, pp 229-240) ADDITIONAL REPORT RELATIVE TO THE SUBJECT "HARMONIZATION OF THE CONDITIONS OF AUTHORIZATION INCLUDING ENVIRONMENTAL PROTECTION WITH REGARD TO THE LOCATION OF NUCLEAR POWER PLANTS". Fernandez, Enrique Castellon. Nov 1973. (In Spanish).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The Spanish siting regulations are summarized. Additions and modifications to these original regulations are discussed. The philosophy behind the regulations adopted is briefly outlined. (JSR)

5669 (CONF-730979-, pp 257-271) NEW ORIENTATIONS OF THE ITALIAN NUCLEAR LEGISLATION IN POINT OF AUTHORIZATIONS. Nocera, F. (CNEN, Rome); Carbone, F. Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The draft of the bill indicates modifications to "latu sensu" authorizing system of radioactive material. Such modifications, besides concerning the juridical system for the possession of such material (especially special fissile material), interest to a considerable extent the present authorizing regime regarding transportation. This bill purports to innovate by requesting solely the observance of the constituent technical regulations forming the object of the regulations to be issued, already specifically envisaged by the base nuclear law of 1962. Several

modifications are also envisaged with regard to the public liability connected with the transportations in point. A modification proposal concerning the location of the plants for the production of electric power, though not envisaging innovations in the nuclear provisions proper, is interested on a long term basis in both thermal and thermal-nuclear plants, with aftermaths therefore on the general regulations of power plants. (auth)

5670 (CONF-730979-, pp 273-274) COMMENT ON THE REPORT OF B. MOSER. Virole, J. (Electricite de France, Paris). Nov 1973. (In French).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

In commenting on the operation of nuclear plants close to national borders it is emphasized that the solution of the problems caused must be multilateral, institutional, and operational. (JSR)

5671 (FIND-50244-R1) FIND: ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Items 1-232. Asher, J. M. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Apr 1974. 24p. Dep. NTIS $4.00.

An index is presented for microfiche copies of the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfische sheets prepared for each docket report. (auth)

5672 (WASH-1306) ACTION PLAN: TO SHORTEN CONSTRUCTION TIME OF NUCLEAR POWER PLANTS. (USAEC, Washington, D.C.). 15 Apr 1974. 26p. Dep. NTIS $4.50.

Discussions have been held with utility companies, construction contractors, architect/engineers, vendors and suppliers to obtain their views concerning problems that relate to the causes of slippages in the completion of construction of nuclear power plants. The first set of problems stated are changes in design imposed by AEC, architect/engineers, ASME and others which cause redesign and construction delays. The second category concerns problems with the nonavailability of material and equipment on the job site when the schedule calls for its installation. The third category of problems relates to various aspects of the work force. This plan discusses those items which are common in occurrence. Each of the items will be presented as a problem, discussed in enough detail to outline the dimension of the problem, and the actions and action agencies recommended will be specified. Agencies which can usefully take action on any item will be asked to keep the Director of Regulation informed. (auth)

5673 SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY, SESSION 1972-73. Nuclear Power Policy. Minutes of Evidence, Appendices, and Index. London; Her Majesty's Stationery Office (1973). 117p.

Evidence was given by the Department of Trade and Industry, the Central Electricity Generating Board, the UK Atomic Energy Authority and by representatives of nuclear industry. Memoranda were presented on several aspects of nuclear power policy, including: future nuclear reactor policy, the fast reactor program in the UK, the work of the nuclear inspectorate, nuclear industry in the UK, Dungeness "B" nuclear power station contract, the Capenhurst diffusion plant, comparative costs of electricity generation. (UK)

5674 BASIC PLAN FOR ESTABLISHMENT OF ATOMIC POWER PLANTS. Taki, M. (Tokyo Electric Power Co. Inc.). Hoikan Gijutsu; 15: No. 13, 51-54 (Sep 1973). (In Japanese).

Techniques of planning, procedures for granting the permission of the construction of atomic power plants, and methods for selecting sites and the construction works are described. A standard type atomic power plant with boiling water reactors, including atomic reactors and turbines, is illustrated. The guide lines to assess the establishment of atomic reactors, presented by the Expert Committee for Safety of Atomic Reactor of the Atomic Energy Committee, are mentioned. Problems related to the procedures for granting permission of construction plans and the methods for presenting data were pointed out. Lastly, planning characteristics for the construction of atomic power plants, including plumbing, were stated. (JA)

5675 LEGAL AND ADMINISTRATIVE PROCEDURES FOR LICENSING AND REGULATION OF NUCLEAR POWER PLANTS IN THE UNITED STATES. Rowden, M. A. (Atomic Energy Commission, Washington, DC). pp 483-511 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some problems in connection with legal and administrative procedures for licensing and regulation of nuclear power plants in the United States are described. (INIS)

5676 PREPARATORY STEPS FOR START-UPS. Polliart, A. J. (CEN de Saclay, Gif-sur-Yvette, France). pp 393-407 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Information is presented about preparatory steps for start-ups. The design, preparation of tenders and signature of agreements are followed by the manufacturing of equipment according to detailed studies, then site construction and commissioning. All those steps might be considered as preparatory for start-up, since criticality and net power will constitute the final judgement of all the activities listed above, both from the nuclear and commercial points of view. Commissioning activities are restricted to those which are carried out on the site where the nuclear power plant is under construction. However, factory tests must be considered a very important factor. (INIS)

5677 PROPOSED GUIDELINE FOR QUALITY ASSURANCE FOR CONSTRUCTION OF NUCLEAR POWER PLANTS. Nogaito, T. (Japan Atomic Power Co., Tokyo). pp 387-392 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

This guideline presents measures for confirming quality assurance that the plant owners should take in each of the stages of nuclear power plant construction, from the equipment design through the preoperation tests, for the purposes of assuring proper performance of the power plant with respect to safe operation, the health and safety of the public and the plant employees, and of the reliability in power supply from the power plants. (INIS)

GENERAL

Information Handling

5678 STATISTICAL ANALYSIS ON INDEXING DEPTH IN INIS. Komatsubara, Y. (Japan Atomic Energy Research Inst., Tokai). Dokumenteshon Kenkyu; 23: No. 9, 287-293(Sep 1973). (In Japanese).

The indexing tendency in INIS was analyzed by a statistical means. In this analysis were counted the indexer assigned descriptors per piece of literature and the computer generated broader terms per indexer assigned descriptor, and also the number of split documents. The INIS employs a decentralized input system, and further, the indexing itself differs with the respective subject categories. The numbers of descriptors and broader terms and of split documents were obtained for each inputting country and subject category. The difference in indexing among the countries for given subject category was considerably large, far more than expected. The indexing depth is then related not only with the number of descriptors per piece of literature, it is also largely influenced by the ratio of computer- and indexer-assigned descriptors. (auth)

Law

Refer also to abstracts 3151 and 5667–5669.

5679 (CONF-730979-) NUCLEAR INTER JURA '73. Dokumentation. 1st International Conference on Nuclear Law, Karlsruhe, Germany, September 11–14, 1973. (International Nuclear Law Association (INLA), Brussels (Belgium); Kernforschungszentrum Karlsruhe (F.R. Germany)). Nov 1973. 493p. (In several languages).

Abstracts were prepared for twenty-three papers of the twenty-eight presented at the 1st International Conference on Nuclear Law. Five of the papers have previously appeared in NSA. (MCW)

For abstracts of individual papers see: 5493–5496, 5648, 5664–5670, and 5680–5690.

5680 (CONF-730979-, pp 33-43) OBJECTIVES AND PURPOSES OF THE INTERNATIONAL NUCLEAR LAW ASSOCIATION—INLA. Fischerhof, H. (Univ., Frankfurt am Main). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The Association has the primary objective of the study and knowledge of juristic problems of the peaceful use of nuclear energy with special consideration of the safety of man and the environment and the promotion of the interchange of information. These goals are discussed. (JSR)

5681 (CONF-730979-, pp 85-90) PROBLEMS CONCERNING THE REVISION OF THE PARIS CONVENTION ON THIRD PARTY LIABILITY IN THE FIELD OF NUCLEAR ENERGY. Marchetti, D. (Ministry of Industry, Rome). Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

An examination is made of the situation whereby Italy was a member state actively engaged in the founding of the Paris Convention on Third Party Liability in 1960, but has not yet ratified the convention. Italy has patterned its internal atomic energy laws on the laws of the Paris Convention. Some comparisons with the Vienna Convention on Civil Liability for Nuclear Damage are made. (MCW)

5682 (CONF-730979-, pp 105-128) ADAPTING NUCLEAR LIABILITY CONVENTIONS TO THE STATE OF THE ART. Pfaffelhuber, J. K. (Bundesministerium des Innern, Bonn). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The present state of the liability conventions is analyzed. Proposals are made for a future revision of these conventions. (JSR)

5683 (CONF-730979-, pp 129-138) INSURANCE ASPECTS OF THE PARIS CONVENTION FROM THE U.K. POINT OF VIEW. Campbell Miles, A. (British Insurance (Atomic Energy) Committee, London). Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The flexibility in the insurance provisions in the Paris Convention is discussed. Each state may decide for itself the most convenient method of carrying out adequate compensation for any third party damage that is endured. The position under United Kingdom nuclear legislation is presented. The exceptional nature of the third party liability of the operator of a nuclear installation imposed by the Paris Convention that necessitates the departure from the conventional forms of insurance is examined. (MCW)

5684 (CONF-730979-, pp 139-154) INTERNATIONAL RESPONSIBILITY OF STATES FOR THE PEACEFUL USE OF NUCLEAR ENERGY. Zaldivar, E. (Univ., Buenos Aires). Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

Attention of jurists is needed for observance on the responsibilities of states for damages that may be caused by the use of nuclear power for peaceful uses. Peaceful uses of nuclear energy in medicine, agriculture, industry, and the production of electric power are cited. A certain amount of risk, although limited and remote, is present. A twofold presentation of the problem involves that of civil liability and that of the international liability of states. (MCW)

5685 (CONF-730979-, pp 241-255) RECENT ADDITIONS TO THE SPANISH NUCLEAR LAW. Tocino, I. (Univ., Madrid). Nov 1973. (In Spanish).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

Legislative and administrative acts that have the effect of modifying the Spanish nuclear law are summarized. Jurisprudence resolutions affecting nuclear installations are discussed. Contributions of the scientific community to the legal control of nuclear installations are indicated. Seminars and courses on nuclear law held in Spain are described. (JSR)

5686 (CONF-730979-, pp 315-332) IAEA SAFEGUARDS IN CONNECTION WITH NPT AND THE IAEA–EURATOM SAFEGUARDS AGREEMENT. Stein, R. M. (IAEA, Vienna). Nov 1973.

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

A new era of international safeguards was greatly expanded by the advent of the NPT in 1968. A general view and analyses of the international agreements are discussed. The IAEA agency is applying safeguards in connection with NPT in 26 countries and 17 other agreements have either been signed or approved by the Board of Governors. Some 24 agreements are currently under negotiation. Agency safeguards are being applied in connection with 20 project agreements and under 27 safeguards transfer agreements and 4 unilateral submission agreements. (MCW)

5687 (CONF-730979-, pp 375-382) PROBLEMS IN IMPLEMENTING NUCLEAR SAFEGUARDS (CONTROL OF THE FLOW OF FISSILE MATERIAL). Gupta, D. (Kernforschungszentrum, Karlsruhe, Ger.). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

Problems in the control of fissile materials can be considered under the categories of EURATOM control under the Rome convention and EURATOR-IAEO control under the NV convention, obligations on the international and national level, interpretations of the individual articles, and carrying out safety control in existing nuclear installations. Each of these categories is discussed on the basis of several examples. (JSR)

5688 (CONF-730979-, pp 383-394) LEGAL PROBLEMS OF PEACEFUL NUCLEAR EXPLOSIONS. von Welck, S. F. (Bundesministerium fuer Forschung und Technologie, Bonn). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The narrow line separating peaceful nuclear explosions and nuclear explosions with a military objective is discussed. The primary problems in peaceful nuclear explosions are the extent of the liability, procedure, and organization of nuclear explosions according to international conventions and under international monitoring, and the legal difficulties. Each of these is discussed. (JSR)

5689 (CONF-730979-, pp 399-407) PRESUMPTIONS OF CAUSALITY IN NUCLEAR LAW. Moser, B. Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

The special problems found in the question of causality under

nuclear law are briefly outlined. The response of the Austrian law to these problems is discussed. (JSR)

5690 (CONF-730979-, pp 471-481) DOSE LIMITS AND SOCIAL INSURANCE. Fischerhof, H. (Univ., Frankfurt am Main). Nov 1973. (In German).

From 1st international conference on nuclear laws, Nuclear Inter Jura '73; Karlsruhe, F.R. Germany (11 Sep 1973).

German laws governing dose limits and causality in social insurance and the difficulties in interpretation are summarized. (JSR)

5691 SELECTED MATERIALS ON ATOMIC ENERGY INDEMNITY AND INSURANCE LEGISLATION. Joint Committee on Atomic Energy, Congress of the United States, Ninety Third Congress, Second Session. Washington, DC; Joint Committee on Atomic Energy (1974). 574p. GPO $4.00.

5692 EXPERIENCE WITH THE NS OTTO HAHN. Ulken, D. (Zagreb Univ.). (1973). vp. (In German).

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The good operational experiences up to present are outlined. The time-consuming procedure of negotiating bilateral agreements relating to the safety of nuclear ships and the liability problems associated with the docking in foreign harbors is discussed. (auth)

5693 NUCLEAR SHIPS IN THE MARITIME LAW OF YUGOSLAVIA. Filipovic, V. (Zagreb Univ.). (1973). vp. (In German).

From 1st international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

Applied are the safety regulations of the SOLAS agreement and the regulations of the International Law. Nuclear ships under foreign colors obtain permission to enter harbor only after examination of the safety report. The problems of nuclear ships distressed at sea are discussed. The completely insufficient liability of shipping companies according to the French Code de Commerce (1807) will be substituted by a sea and inland navigation law presently in preparation. For the first time, liability regulations will be provided for in compliance with the principles of BCOLONS. (auth)

Management

Refer also to abstract 5231.

5694 (AECL-4591) ONE-DAY INTRODUCTION TO RADIATION PROTECTION PRINCIPLES. Fenn, J. H.; White, J. M.; Watson, L. C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1974. 51p. Dep. NTIS (U. S. Sales Only) $5.75.

The fundamentals of radiation hazards and their control are outlined. This one-day course is presented to all classes of radiation workers at CRNL, usually during their first month of employment. The purposes of the course are to outline the fundamentals of radiation hazards control, to describe methods that enable employees to work safely with radiation, and to acquaint employees with the CRNL radiation and industrial safety organization. (auth)

5695 (GEPP-121) CONTAMINATION CONTROL TRAINING MANUAL. Meeks, R. F. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 1 Apr 1974. Contract AT(29-2)-656. 165p. Dep. NTIS $11.25.

This manual presents a basic industrial contamination control training course. Topics cover the types and identification of environments contaminants, their sources, as well as controls for all types of contaminants on surfaces, in liquids and gases, and airborne. The course emphasizes the integration of the employee into the contamination control program. Contaminants considered include particulates, gases, liquids, dissolved chemicals and oxygen, microorganisms, and radiation including radioactivity emitted by radioactive materials, infrared, uv, radio waves, visible light, heat, sound, and vibration. Methods for controlling radiation contamination discussed include eliminating the radiation source, reducing the intensity of the energy emitted from the source, shielding the contaminee from the radiant energy, or some combination of the three. It is pointed out that the techniques required to control radiation contamination may be quite complex. (CH)

5696 (INIS-mf-368) 13. PROGRESS REPORT. (Nuclear Energy Agency, 75-Paris (France)). Dec 1971. 99p. (In French). INIS.

The activities of ENEA during 1971 are reviewed: enterprises and services of the nuclear energy community, scientific and technical cooperation, health and safety, and legal questions. Some new activities were initiated: a communal project for testing the wholesomeness of irradiated food was undertaken by twenty countries; preliminary studies were undertaken in view of developing a common program for fast water cooled reactors; a new operation of disposing radioactive wastes in the deep parts of the Atlantic Ocean was developed; information handling and diffusing problems arising from the putting into operation of the INIS Nuclear Information System by the AIEA were studied; a new project for a convention concerning liabilities involved in conflicts between nuclear and maritime laws was also initiated. (FR)

5697 (INIS-mf-961) AEB HIGHLIGHTS. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Jul 1972. 5p. (In Afrikaans). INIS.

AEB HIGHLIGHTS is a semi-annual report reflecting the most important recent achievements of the various Research and Technical Divisions of the AEB. It appears alternately in English and Afrikaans. (auth)

5698 (INIS-mf-1177) SEVENTEENTH ANNUAL REPORT, 1972-73. (Atomenergikommissionen, Copenhagen (Denmark)). Nov 1973. 64p. INIS.

Activities of the Danish Atomic Energy Commission and the Risø Research Establishment for the period April 1, 1972 to March 31, 1973 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, a selected list of staff publications is given, and the design data on research facilities are presented. (Denmark)

5699 (INIS-mf-1183) IMPACT OF SCIENCE AND TECHNOLOGY ON GOVERNMENT ADMINISTRATION. Venkataraman, G. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 21p. INIS.

The impact of science and technology in general and of Indian nuclear energy program in particular on government administration in India is discussed. Government funding of research activities in science and technology in this century is explained. With the emergence of nuclear energy as a source of electric power, the heavy responsibilities imposed on the government in safeguarding national interests are pointed out. The administrative patterns of the Council of Scientific and Industrial Research, the Department of Atomic Energy, and the Atomic Energy Commission are compared. The need for proper administrative set-up to suit the program in hand is stressed for the rapid growth of science and technology. (MCW)

5700 (INIS-mf-1227) AB ATOMENERGI, 1972. Statement by the Board and the Managing Director. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 17p. INIS.

A description is given of AB Atomenergi that is the central organization for research and development in the nuclear energy field in Sweden. The main task of the company is research and development to support the Swedish program on light water reactors. AB Atomenergi advises the government on nuclear matters. For the most part the company works on a contract basis for customers within Sweden as well as abroad. (Sweden)

5701 (STI/DOC-10-152) EVALUATION OF RADIATION EMERGENCIES AND ACCIDENTS: SELECTED CRITERIA AND DATA. Vallario, E. J. (International Atomic Energy Agency, Vienna (Austria)). Mar 1974. 142p. IAEA $6.00.

This manual is intended to provide a convenient reference to criteria and data which would be useful in evaluating the consequences of radiation emergencies and accidents. Topics discussed include: methods of estimating the environmental hazards from airborne releases of radioactivity; emergency radiation dose assessment, including intakes of radioactivity and external radiation intensity and corresponding dose, the maximum permissible intake data for significant radionuclides, selected biological dosimetry methods for emergency use, and dose assessment from transuranic elements; criteria and data for controlling radioactive contamination of personnel and the environment, including decontamination methods; evaluation of air samplers and air filters; respiratory protectors, and protective clothing; radiation shielding; and conversion factors applicable to radiation protection. (CH)

5702 (Y-1A-125) CASE STUDY OF PREVENTIVE MAINTENANCE AT THE OAK RIDGE Y-12 PLANT. Price, G. S, Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 33p. (CONF-740421-1). Dep. NTIS $4.50.

From the American Management Association meeting; Atlanta, Georgia, USA (18 Apr 1974).

5703 AUTHORIZING APPROPRIATIONS FOR THE ATOMIC ENERGY COMMISSION FOR FISCAL YEAR 1975. Report by the Joint Committee on Atomic Energy, Ninety Third Congress, Second Session. Washington, DC; Joint Committee on Atomic Energy (1974). 60p. GPO.

5704 WHAT IS THE POINT OF INFORMING THE PUBLIC ABOUT HIGHLY COMPLEX TECHNOLOGY? Courvoisier, P. (Eidgenoessiches Amt fuer Energiewirtschaft, Wuerenlingen, Switzerland). Atomwirt. Atomtech.; 19: No. 1, IV(Jan 1974). (In German).

Some significant parts of a lecture by the head of the department for the safety of nuclear power plants of the Swiss national board for power engineering are discussed. (GE)

5705 NUCLEAR INDUSTRY. Eister, W. K.; Kennedy, R. H. (Atomic Energy Commission, Germantown, MD). pp 719-771 of Riegel's Handbook of Industrial Chemistry. Kent, J. A. (ed.). New York; Van Nostrand Reinhold Co. (1974).

The U. S. nuclear industry is outlined with emphasis on the economics and the useful products of nuclear energy. Topics discussed in separate sections include: the earth's energy supply; nuclear energy economics; nuclear reactions; explosives; reactors; reactor fuel processing; gaseous diffusion enrichment; spent fuel reprocessing; waste management; radioisotope and stable isotope production and use; and nuclear safety. (HDR)

5706 RIEGEL'S HANDBOOK OF INDUSTRIAL CHEMISTRY. Seventh Edition. Kent, J. A. (ed.). New York; Van Nostrand Reinhold Company (1974). 908p. $37.50.

Twenty seven chapters are presented in which the many facets of the chemical process industry are reviewed. One chapter, on chemical processes in the nuclear industry, was abstracted for NSA. (HDR)

For an abstract of an individual chapter see: 5705.

5707 EXPERIENCE IN HEALTH PHYSICS TRAINING. Bocquet, H. (CEN, Fontenay-aux-Roses, France). pp 375-378 of Seventh National Congress of the Health Physicist's Association. Marseilles; Centre National de la Recherche Scientifique (1973). (In French).

From seventh national congress on control of ionizing radiation: pollution, dosimetry, applications; Marseilles, France (16 May 1972).

It is shown that radiological protection is based on three inseparable requirements: the respect of the health physics criteria laid down, i.e., security standards; the prevention and protection against irradiation and contamination; and the surveillance and control of installations and personnel. The most important aspect of radioprotection is prevention and prevention is translated by experience. Health physics training began in the CEA 10 years ago. Experience has shown that the problem of personnel training cannot be separated from that of providing appropriate information to all persons exposed to radiation during their work. This information can only be provided by technically competent persons. Although the CEA can be cited as an example in the domain of prevention, many problems still remain concerning the definition of technical competence in this field. (FR)

Mathematics and Computers

Refer also to abstracts 3570, 3571, 5825, 5826, and 5831.

5708 (CALT-767-P-3-32) COMPUTER ENHANCEMENT OF WEAK BEAM IMAGES. Horgen, H. M.; Villagrana, R. E.; Maher, D. M. (California Inst. of Tech., Pasadena (USA)). [nd]. Contract AT[04-3]-767. 4p. Dep. NTIS $4.00.

5709 (CEA-CONF-2515) SERIAL SEMICONDUCTOR MEMORIES AND REFRESH MEMORIES. Borel, J.; Mackowiak, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 13 Aug 1973. 90p. (CONF-730859-1). Dep. NTIS (U. S. Sales Only) $7.50.

From semiconductor memory device and circuit summer course; Louvain, France (27 Aug 1973).

5710 (CEA-CONF-2549) SIGNAL PROCESSING AND CYBERNETICS. Max, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 8 Jan 1973. 28p. (In French). (CONF-7309102-1). Dep. NTIS (U. S. Sales Only) $4.50.

From seventh international congress on cybernetics; Namur, Belgium (10 Sep 1973).

5711 (CEA-CONF-2583) COMPARISON OF TWO THEORETICAL DECONVOLUTION METHODS. Garderet, P.; Lecomte, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 27 Aug 1973. 37p. (In French). (CONF-730688-1). Dep. NTIS (U. S. Sales Only) $5.00.

From seminar of the users of signal processing; Grenoble, France (15 Jun 1973).

5712 (CERN-74-7) NUMERICAL CALCULATION OF SUCCESSIVE PARTIAL DERIVATIVES OF FUNCTIONS WITH TWO AND THREE VARIABLES. Applications to the Taylor-McLaurin Development. Barthelemy, J. F. (European Organization for Nuclear Research, Geneva (Switzerland)). 28 Mar 1974. 43p. (In French). Dep. NTIS (US Sales Only) $5.25.

5713 (COO-1437-12) STUDY OF MATHEMATICAL MODELS OF MUTATION AND SELECTION IN MULTI-LOCUS SYSTEMS. Three Year Progress Report, December 1, 1970-November 30, 1973. Lewontin, R. C.; Slatkin, M. (Chicago Univ., Ill. (USA). Dept. of Theoretical Biology). 1973. Contract AT(11-1)-1437. 20p. Dep. NTIS $4.00.

5714 (CTC-INF-1068(Rev.1)) APPROXIMATE SIMULATION OF A VERY COMPLEX COMPUTER SYSTEM. Burris, R. D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). [nd]. Contract W-7405-eng-26. 9p. (CONF-740605-1). Dep. NTIS $4.00.

From symposium on the simulation of computer systems; Gaithersburg, Maryland, USA (4 Jun 1974).

5715 (HASL-283) OPERATING MANUAL FOR GRANIA, A CODE FOR THE ANALYSIS OF CLIMATIC EFFECTS ON NATURAL ENVIRONMENTAL GAMMA-RAY EXPOSURE RATES. Burke, G. deP.; O'Brien, K. (USAEC Health and Safety Lab., New York). Apr 1974. 14p. Dep. NTIS $4.00.

A computer code (GRANIA) was developed to determine the effect of climatic factors on the background exposure rate from γ sources in the ground. The input to the code is described and a sample calculation given. The code takes into account variations both in water storage within the soil-water medium and in surplus water, and their effect on γ levels. It is written in FORTRAN IV for the IBM 360-30. (auth)

5716 (INT-45) ANALOG FUNCTION MODULES. Korbel, K.; Lacki, E. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). Nov 1973. 32p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.75.

5717 (IPP-2-216) CYCLIC FOUR-CHANNEL DATA STORAGE. Jaeckel, H. J.; Kisslinger, J.; Rau, F.; Schmaeling, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Nov 1973. 18p. (In German). Dep. NTIS (US Sales Only) $4.00.

5718 (JUL-1029-RG) MOVI-3D, A PLOT-PROGRAM FOR 3-DIMENSIONAL REPRESENTATION OF KINETIC PROCESSES IN 16 MM-FILMS. Boumans, S.; Lauer, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Dec 1973. 51p. (In German). Dep. NTIS (US Sales Only) $5.75.

The documentation for MOVI-3D contains the utilization instruction, the input description, technical informations about the code, and an application example. The program system MOVI-3D, with the aid of microfilm plotter CALCOMP-1670, produces completely computer-made 16 mm films of evaluated kinetic processes in a general and flexible way. As input any set of matrixes may be submitted that represent snap-shots of a function of two discrete variables proceeding in time in a continuous or piece-wise continuous manner. By linear or square time interpolations, the code computes a sequence of intermediate function fields. These are then plotted as a consecutive series of pictures in a perspective three-dimensional representation on the 16 mm film. The MOVI-3D film program allows for flexible direction of scenes, choice of variable projection angles and fade-overs, as well as insertion of plotted illustration text if desired. (auth)

5719 (KFK-PDV-15) STATIC OPTIMIZATION OF TECHNICAL PROCESSES. Bamberger, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Aug 1973. 59p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

5720 (LBL-2675) CONFERENCE PROGRAMS WITH INTERACTIVE GRAPHICS. Austin, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1974. Contract W-7405-eng-48. 19p. (CONF-740512-7). Dep. NTIS $4.00.

From second AEC scientific computer information exchange meeting; New York, New York, USA (2 May 1974).

5721 (MATT-1034) AREAD: AN INPUT DATA PROCESSING ROUTINE. Price, W. G. Jr. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1974. Contract AT(11-1)-3073. 18p. Dep. NTIS $4.00.

5722 (MATT-1036) LIBMAK: A PROGRAM TO MANIPULATE ANISH-TYPE BINARY LIBRARIES. Price, W. G. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1974. Contract AT(11-1)-3073. 11p. Dep. NTIS $4.00.

5723 (ORNL-TM-4528) OAK RIDGE SYSTEMS ANALYSIS CODE (ORSAC) INPUT INSTRUCTIONS. Bauman, H. F. (Oak

Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 33p. Dep. NTIS $4.75.

5724 (SLA-74-5215) NONLINEAR CONTINUA. Von Riesemann, W. A.; Stricklin, J. A.; Haisler, W. E. (Sandia Labs., Albuquerque, N. Mex. (USA); Texas Agricultural and Mechanical Univ., College Station (USA)). 1974. 35p. (CONF-740604-3). Dep. NTIS $4.75.

From international symposium on structural mechanics software; College Park, Maryland, USA (12 Jun 1974).

The software available for nonlinear continuum is surveyed, and where possible assessments are made. Primarily, the nonlinearities considered are geometric (large displacement), material, and large strain. The main emphasis of the paper is on the actual software and not on the methods of analysis. The programs surveyed fall into two categories: the so-called hydrodynamic or wave propagation codes, which are primarily finite difference, and structural response codes that primarily use the finite element method for solids and both finite difference/element methods for shells. Some guidelines and suggestions for potential users are discussed. The survey includes programs that will be available in the near future. 97 references. (auth)

5725 (SLA-74-5248) USAGE AND ARGUMENT MONITORING OF MATHEMATICAL LIBRARY ROUTINES. Bailey, C. B.; Jones, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 35p. (CONF-740511-3). Dep. NTIS $4.75.

From mathematical software II conference; Lafayette, Indiana, USA (29 May 1974).

5726 (UCID-30092) ZEROIN: A SUBROUTINE TO CALCULATE ONE REAL ZERO OF A REAL CONTINUOUS FUNCTION. Leonard, L. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1974. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

ZEROIN is a subroutine that calculates one zero of a real continuous function f, given two points b and c, such that f(b)· f(c) 0. ZEROIN is programmed in ANSI Standard Fortran and uses a combination of bisection and the secant rule to find the zero. (auth)

Miscellaneous

Refer also to abstract 5713.

5727 (BNL-18833) LIMITS OF IMPOVERISHMENTS: A NEW GREAT ISSUE. Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 19p. (CONF-740213-5). Dep. NTIS $4.00.

From 140th meeting of The American Association for the Advancement of Science; San Francisco, California, USA (25 Feb 1974).

5728 (JINR-P4-7782) STABILITY OF THE SYSTEM OF THE PARTICLES WITH POWER INTERACTION IN THE DOUBLE LAYER. Kuz'min, S. K.; Temko, S. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Invariant in Liapounov's sense distributions of the particles in double layer with spherical and elliptic geometric configuration are obtained. (auth)

5729 (JINR-P11-7501) APPLICATION OF GENERALIZED CONTINUOUS ANALOG OF THE NEWTON METHOD TO IMPROPERLY POSED PROBLEMS. Budnyam, S.; Zhidkov, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Some nonlinear improperly posed problems are considered, the numerical solutions of which are obtained by the generalized continuous Newton analog. (auth)

5730 (ORNL-NSF-EP-70) ENVIRONMENTAL QUALITY INDICES. Thomas, W. A. (Oak Ridge National Lab., Tenn. (USA)). Jul 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

A final report is presented which summarizes work conducted at ORNL during the period from June 15, 1972 to June 1, 1973 on environmental indices. Information is included on: the distribution and use of the Oak Ridge Air Quality Index; development of both a statistically-based index, APINDEX, and a dual-purpose index for evaluating short- and long-term trends in air quality; work on water quality indices at Vanderbilt University and by the National Sanitation Foundation; publication of a bibliography on "Biological Indicators of Environmental Quality"; correlations of air quality indices with human health; and methods of implementing a system of environmental indicators. (LCL)

5731 (SLA-74-5238) DETECTION BY AUGER ELECTRON SPECTROSCOPY AND REMOVAL BY OZONIZATION OF PHOTORESIST RESIDUES. Holloway, P. H.; Bushmire, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 26p. (CONF-740426-1). Dep. NTIS $4.50.

From international reliability physics symposium; Las Vegas, Nevada, USA (2 Apr 1974).

Surface chemical analyses by Auger electron spectroscopy (AES) indicate that hydrocarbon residues are frequent contaminants on gold hybrid microcircuit metallization. The primary electron beam for AES cracks the hydrocarbon contaminants causing a carbonaceous residue. Lead frame bonding data demonstrated that a carbon residue approximately 10 Å thick was indicative of thermocompression bond degradation. Concentrations of two percent ozone in oxygen can remove a photoresist layer approximately 200 Å thick in 100 hours at room temperature. This restores thermocompression bondability of gold surfaces. (auth)

5732 (UCID-16449) ANATOMY OF A FREEWAY. Collins, J. C.; Epps, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Feb 1974. Contract W-7405-eng-48. 30p. (CONF-740124-1). Dep. NTIS $4.50.

From joint mechanical engineering–electrical engineering colloquium; Livermore, California, USA (11 Jan 1974).

A new theory, called the Headway Control theory, is offered to explain the behavior of vehicular traffic. It presumes that driver behavior is based upon time headways and that the value of the desired headway is determined by the combined perception time and reaction time of the individual driver. A mathematical model based upon this theory is developed and examined. The characteristics of the model are explored and simulation studies are run comparing the behavior of the model to real traffic. Model behavior is also examined when an automatic traffic control is impressed upon it. (auth)

5733 (UCRL-51561) LINE BROADENING AND COLLISIONAL STUDIES OF CO_2 USING THE TECHNIQUES OF SATURATION SPECTROSCOPY. Meyer, T. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1974. Contract W-7405-eng-48. 225p. Dep. NTIS $7.60.

Thesis.

A high resolution spectrometer is constructed for the purpose of making line broadening and collisional studies of CO_2 using saturation spectroscopic techniques. The primary purpose of these measurements is three fold: to obtain the pressure broadening coefficients for CO_2 in collision with a variety of foreign gas perturbers, to characterize the nonlinear interaction of a CO_2 laser electric field with the absorbing CO_2 medium in the formation of the saturated resonance (Lamb dip), and to investigate the forces involved in intermolecular collisions using the data of 1. (JFP)

5734 (WASH-1275) GLOSSARY OF VIDEO TERMS, DEFINITIONS, AND ABBREVIATIONS. (USAEC Division of Headquarters Services, Washington, D. C.). Jan 1974. 47p. Div. of Headquarters Services, Washington, DC. Free.

5735 (WASH-1276) VIDEO PRODUCTION GUIDELINES AND TECHNIQUES. (USAEC Division of Headquarters Services, Washington, D. C.). Jan 1974. 17p. Div. of Headquarters Services, Washington, DC. Free.

5736 (ZAED-BIBL.-39-1) PATENTS '72. German Patents Concerning Nuclear Science and Technology. (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Jul 1973. 67p. (In German). INIS.

The bibliography contains all patent claims, Offenlegungsschriften and Auslegeschriften (patent applications prior to and after examination by the patent office) on nuclear science and technology and related fields, which have been claimed during the year of 1972 from the German Patent Office in Munich, and which fall under the subject scope of the International Nuclear Information System (INIS). About 20% of these could be included in the INIS Atomindex. The bibliographic description, the subject classification and index terms correspond to the INIS rules. According to these rules, the claims considered to have foreign priority are only those of the USA, USSR and Great Britain, the international (Int. Cl.) and national (German (F. R.) Cl.) patent classification is given with the bibliographic description for each document. The bibliography includes an author index, a corporate author index and a number index. (GE)

5737 GUIDE TO PRACTICAL TECHNOLOGICAL FORECASTING. Bright, J. R.; Schoeman, M. E. F. (Eds.). Englewood Cliffs, NJ; Prentice-Hall, Inc. (1973). 667p. $49.50.

One of the 37 sections is abstracted for NSA. The section abstracted concerns public resistance to the siting of nuclear power plants. The other 36 sections present information concerning the improvement of technological forecasting, advances in technological forecasting techniques, technological forecasting applied to

current problems, expanding the scope of technological forecasting, and organizing for technological forecasting. (DCC)

Chemistry

5738 (BARC/I-220) BENEFICIATION OF GRAPHITE ORE FROM CHHOTA UDEPUR, GUJARAT (ANAND MINERALS). Narasimham, J. B.; Kamat, A. K.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

5739 (BARC/I-221) BENEFICIATION OF GRAPHITE ORE FROM DEOGARH BARIA (JHAB REDHANA). Narasimham, J. B.; Kamath, A. K.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

5740 (BARC/I-222) BENEFICIATION OF GRAPHITE ORE FROM DEOGARH BARIA, GUJARAT (HASHVIN MINERALS). Narasimham, J. B.; Kamath, A. K.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

5741 (BDX-613-1048(Rev.)) COMPARISON OF METHODS FOR CLEANING CONTAMINATED SURFACES. Jackson, L. C. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 14p. Dep. NTIS $4.00.

A study was made of alternate cleaning procedures used in the manufacture of electronic assemblies. Two entirely different means of evaluating the effectiveness of the cleaning procedures on plastics and metals were utilized: determination of strength of bonded specimens, and contaminant detection by evaporative rate analysis. Interpretive analyses are presented to explain the apparent conflict of conclusions yielded by the testing techniques. Insight was obtained into the effectiveness of cleaning procedures used to remove contaminants. (auth)

5742 (CEA-R-4569) THIRD PHASE FORMATION IN ORGANIC SOLUTIONS IN THE EXTRACTION OF MONOACIDS BY DILUTE TERTIARY TRIALKYLAMINES IN VERY SLIGHTLY POLAR ORGANIC SOLVENTS. Robaglia, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie). 1974. 203p. (In French). Dep. NTIS (US Sales Only) $13.25.

Thesis.

5743 (ORNL-tr-2806) LIQUID-VAPOR EQUILIBRIUM OF THE TERNARY SYSTEM $H_3PO_4-HNO_3-H_2O$. Distillation Trajectories of Mixtures Composed of Phosphoric and Nitric Acids and Water. Flatt, R.; Bonnet, J. Translated by Martha Gerrard from Chimia (Aarau); 12: 343-50(1958). 14p. Dep. NTIS $3.00.

Numerous determinations were made of the composition of the vapor released at the boiling point of mixtures of phosphoric and nitric acids and water. The results of these determinations were used to construct a phase diagram for the liquid-vapor equilibrium of the ternary system $H_3PO_4 + HNO_3 + H_2O$. In the triangular diagram representing the liquid phases, the isonitrates (locus of liquid mixtures releasing a vapor of the same composition) for the liquid phases producing a vapor with 1.5, 3, 5, 10, 20, 30, 40, 50, 60, 70, and 80% HNO_3 were constructed. A method is described for constructing, using the isonitrate diagram, the distillation trajectory of mixtures of H_3PO_4, HNO_3, and H_2O. Some special features of the distillation trajectories are discussed. (MCW)

5744 (ORO-1797-50) ENVIRONMENTAL EFFECTS ON f-f TRANSITIONS. IV. Hypersensitive Transitions of Trivalent Lanthanides and the Judd-Ofelt Theory. Henrie, D. E.; Fellows, R. L.; Choppin, G. R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1974. 23p. Dep. NTIS $4.25.

It is proposed that linear correlation between the oscillator strength of hypersensitive transitions in lanthanide spectra of 1:1 and 1:2 complexes and the basicity of the ligand is related to the "covalency" of the metal-ligand bonding. The methods of the Judd-Ofelt theory are applied to previously published oscillator strengths and an interpretation of the variation of the T_λ parameters is presented. The T_2 parameter seems to be most closely associated with lanthanide-ligand "covalency" while the T_4 and/or T_6 parameters seem to reflect the presence (or absence) of a center of symmetry in the lanthanide complex. The inclusion of covalency via configuration interaction involving electron transfer levels is suggested as a theoretical approach to the description of the observed correlations of hypersensitive transition intensity with covalency. (auth)

5745 (UCID-16088) PROPERTIES OF BIS(2,2-DINITROPROPYL)ACETAL AND BIS(2,2-DINITROPROPYL)FORMAL, EUTECTIC MIXTURE. Finger, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1972. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

5746 (UCRL-51546) ESTIMATION OF DIFFUSION COEFFICIENTS AT HIGH TEMPERATURES AND PRESSURES. Miller, D. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Mar 1974. Contract W-7405-eng-48. 25p. Dep. NTIS $4.00.

5747 (UCRL-Trans-1509) ACETALS OF LACTAMS: SYNTHESIS AND SOME CHEMICAL PROPERTIES OF DIETHYLACETAL OF N-METHYLPIPERIDONE-2. Granik, V. G.; Sukhoruchkin, A. G.; Kuryatov, N. S.; Pakhomov, V. P.; Glushkov, R. G. Translated from Khim. Geterotsikl. Soedin., Akad. Nauk Latv. SSR; No. 7, 954-957(1973). 8p. Dep. NTIS $3.00.

5748 (UCRL-Trans-1510) CHEMISTRY OF INDOLE: ON THE INTERACTION OF 2-AMINOINDOLE WITH β-DIKETONES. Sagitullin, R. S.; Mel'nikova, T. V.; Kost, A. N.; Snegirev, V. F.; Frenkel', E. N. Translated from Khim. Geterotsikl. Soedin., Akad. Nauk Latv. SSR; No. 8, 1043-1046(1973). 7p. Dep. NTIS $3.00.

5749 (USC-113-P-19-58) IDENTIFICATION OF RATE CONSTANTS BY DIFFERENTIAL QUADRATURE IN PARTLY MEASURABLE COMPARTMENTAL MODELS. Hu, L. C.; Hu, C. R. (California Univ., Los Angeles (USA)). Jun 1973. Contract AT(04-3)-113. 11p. Dep. NTIS $4.00.

5750 (Y-1941) SULFAMIC ACID CLEANING SOLUTION FOR 4,4'METHYLENE-BIS-ORTHO-CHLOROANILINE (MOCA). Schmitt, C. R.; Cagle, G. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 13 May 1974. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

An aqueous solution of sulfamic acid was developed for decontaminating MOCA-contaminated surfaces to less than the analytical detectable limits for MOCA. No flammability hazards were experienced. (auth)

5751 (Y-1943) RAPID FIELD TEST FOR MOCA. Dietrich, W. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 15 May 1974. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

A rapid color test has been developed for methylene-bis-ortho-chloroaniline (MOCA) by itself and in Adiprene L-100 resin. MOCA, on a polyester substrate, reacts with chloranil in chlorobenzene to give a blue color with an intensity that is proportional to the MOCA content. Color-test sensitivity is magnified for MOCA/resin systems by the presence of reactive MOCA residues in incompletely cured resin polymers. (auth)

Life Sciences

5752 (BNL-18751) ROLE OF A DEOXYRIBONUCLEASE IN BACTERIAL TRANSFORMATION. Lacks, S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 7p. (CONF-740425-1). Dep. NTIS $4.00.

From symposium on mechanisms in recombination; Gatlinburg, Tennessee, USA (1 Apr 1974).

In the genetic transformation of Diplococcus pneumoniae donor DNA is converted to single strands either during or just after its uptake by the cell. This conversion may be regarded as the first step in preparation of the DNA for recombination since a single-strand segment of donor DNA is ultimately inserted into recipient cell DNA. In addition to its role in the recombination process, this step may be an essential part of the mechanism for DNA entry. (MCW)

5753 (BNL-18775) DEVELOPING RATIONAL TREATMENT FOR PARKINSONISM. Cotzias, G. C. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 12p. Dep. NTIS $4.00.

5754 (BNL-18797) EXPERIMENT IN THE EUTROPHICATION OF TERRESTRIAL ECOSYSTEMS WITH SEWAGE: EVIDENCE OF NITRIFICATION IN A LATE SUCCESSIONAL FOREST. Woodwell, G. M.; Ballard, J.; Clinton, J.; Small, M.; Pecan, E. V. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 14p. (CONF-740317-2). Dep. NTIS $4.00.

From conference on the use of waste water in the production of food and fiber; Oklahoma City, Oklahoma, USA (5 Mar 1974).

5755 (CEA-CONF-2500) USE OF A NERITIC-TYPE TROPHODYNAMIC CHAIN WITH MOLLUSKS FOR THE STUDY OF THE TRANSFER OF METALLIC POLLUTANTS. Aubert, M.; Bittel, R.; Laumond, F.; Romeo, M.; Donnier, B.; Barelli, M. (Institut National de la Sante et de la Recherche Medicale (INSERM), 06-Nice (France). Centre d'Etudes et de Recherches Medicales de Biologie et d'Oceanographie Medicale (Cerbom); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 26p. (In French). (CONF-7309103-1). Dep. NTIS (US Sales Only) $4.50.

From sixth international symposium of medical oceanography; Portoros, Yugoslavia (26 Sep 1973).

5756 (CEA-CONF-2511) ELECTRODES IN ELECTROPHYSIOLOGY. Max, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 23 May 1973. 28p. (In French).

(CONF-730478-1). Dep. NTIS (U. S. Sales Only) $4.50.
From course given at the faculty of medicine meeting; Clermont-Ferrand, France (27 Apr 1973).

5757 (CEA-CONF-2592) APPENDIX VASCULARIZATION IN THE RABBIT. A Microscopical and Infrastructural Study. Thiery, G.; Pompidou, A. (CEA, 75-Paris (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). [nd]. 16p. (CONF-730359-1). Dep. NTIS (US Sales Only) $4.00.
From international congress on lymphology; Tucson, Arizona, USA (6 Mar 1973).

5758 (CEA-R-4526) APPLICATIONS OF THE X-RAY'S FLUORESCENCE TO THE MEASURE OF THE LOCAL BLOOD FLOWS. Hellouin, Y. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Apr 1974. 79p. (In French). Dep. NTIS (US Sales Only) $7.00.
Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

5759 (CONF-731141-2) INTRODUCTION: THIRD CONFERENCE ON EMBRYONIC AND FETAL ANTIGENS IN CANCER. Anderson, N. G.; Coggin, J. H. Jr. (Oak Ridge National Lab., Tenn. (USA); Tennessee Univ., Knoxville (USA). Dept. of Microbiology). [nd]. 10p. Dep. NTIS $4.00.
From 3rd conference on embryonic and fetal antigens in cancer; Knoxville, Tennessee, USA (4 Nov 1973).

5760 (CONF-740123-1) APPLICATION OF INTEGRATED GAS CHROMATOGRAPHIC AND MASS SPECTROMETRIC METHODS IN THE IDENTIFICATION OF URINARY CONSTITUENTS ISOLATED BY LIQUID CHROMATOGRAPHY. Mrochek, J. E. (Oak Ridge National Lab., Tenn. (USA)). 1974. 34p. Dep. NTIS $4.75.
From symposium on gas chromatography-mass spectrometry-A new analytical technology; Houston, Texas, USA (29 Jan 1974).

5761 (CONF-740422-1) DISEASES AND PARASITES OF XENOPUS, THE CLAWED TOAD. Cosgrove, G. E.; Jared, D. W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 29p. Dep. NTIS $4.50.
From regional symposium on diseases of aquatic animals of the Gulf Coast area; Baton Rouge, Louisiana, USA (16 Apr 1974).

5762 (COO-875-165) ENERGY TRANSFER MECHANISMS IN PHOTOBIOLOGICAL REACTIONS. Annual Progress Report, 1 August 1973-30 April 1974. Spikes, J. D. (Utah Univ., Salt Lake City (USA). Dept. of Biology). 1974. Contract AT(11-1)-875. 8p. Dep. NTIS $4.00.

5763 (COO-1437-10) STUDY OF MATHEMATICAL MODELS OF MUTATION AND SELECTION IN MULTI-LOCUS SYSTEMS. Annual Progress Report, December 1, 1972-November 30, 1973. Lewontin, R. C.; Slatkin, M. (Chicago Univ., Ill. (USA). Dept. of Biophysics and Theoretical Biology). 1973. Contract AT(11-1)-1437. 13p. Dep. NTIS $4.00.

5764 (COO-1599-62) CARBON CYCLE IN THE EPILIMNION OF TWO MICHIGAN LAKES. Miller, M. C. (Michigan State Univ., East Lansing (USA)). 1972. 232p. (COO-1599-79(Pt.2)). Dep. NTIS $14.75.
Thesis.
The planktonic communities of two contrasting lakes were examined to quantify budgets and dynamics of dissolved and particulate organic carbon. Rates of primary production, extracellular secretion, particulate carbon sedimentation, input of humic material, heterotrophic uptake of glucose, acetate and glycolate, and oxygen depletion were determined in relation to simultaneous measurements of standing crops of algal carbon, total dissolved, and particulate organic carbon and humic organic carbon. (auth)

5765 (COO-1627-28) PHOTO-INITIATED PROCESSES IN VISION. Technical Progress Report, July 1, 1973-June 30, 1974. Guzzo, A. V. (Wyoming Univ., Laramie (USA)). 1974. Contract AT(11-1)-1627. 6p. Dep. NTIS $4.00.
Results are reported from studies on the initial photochemical processes associated with visual excitation in animals. (CH)

5766 (COO-1631-49) PYRUVATE KINASE ISOZYMES IN ADULT TISSUES AND EGGS OF RANA PIPIENS. III. Comparative Studies on the Properties of the Different Isozymes. Schloen, L. H.; Kmiotek, E. H.; Sallach, H. J. (Wisconsin Univ., Madison (USA). Dept. of Physiological Chemistry). 1973. Contract AT(11-1)-1631. 41p. Dep. NTIS $5.25.

5767 (COO-1631-51) SPECIFIC BINDING OF THYROID HORMONES BY HEPATIC NUCLEI EARLY IN AMPHIBIAN DEVELOPMENT. Fischer, M. S.; Cohen, P. P. (Wisconsin Univ., Madison (USA). Dept. of Physiological Chemistry). 1973. 21p. Dep. NTIS $4.25.

5768 (COO-1633-27) STRUCTURE AND SYNTHESIS OF SMALL VIRUSES AND THEIR COMPONENT PARTS. Progress Report, February 16, 1973-February 15, 1974. Kaesberg, P. (Wisconsin Univ., Madison (USA). Biophysics Lab.). 1974. Contract AT(11-1)-1633. 3p. Dep. NTIS $4.00.
Studies involving the structure and mechanism of action of small RNA viruses were continued. The in vitro synthesis of Qβ coat protein provided a very useful system towards clarifying the mechanisms involved in the post-translational cleavage of fMet residues normally associated with protein synthesis in E. coli. Expanded studies are now underway involving the replicase of Qβ as a result of the isolation of an amber mutant that is capable of causing the overproduction of this enzyme. Extracts from wheat embryo were shown to be very useful to study the translation of the RNA components of brome mosaic virus. The wheat system has now been extended to study heterologous messengers, such as Qβ RNA. In the case of Qβ RNA, fidelity of translation was observed although the efficiency of translation was much lower than when the monocistronic BMV coat protein message was used. An evaluation of evolutionary pressures with respect to the extensive secondary structure in mRNAs was also summarized. (auth)

5769 (COO-1668-47) MECHANISMS OF CALCIUM TRANSPORT IN SMALL INTESTINE. Progress Report, June 1, 1973-March 15, 1974. DeLuca, H. F. (Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1668. 12p. Dep. NTIS $4.00.
Low phosphorus diets were shown to stimulate intestinal calcium transport in chicks by stimulating the production of 1,25-dihydroxyvitamin D_3 in the kidney, revealing that serum inorganic phosphorus and hence renal cortex levels of inorganic phosphorus are an important regulator of the synthesis of 1,25-dihydroxyvitamin D_3, the active form of the vitamin in stimulating intestinal calcium transport. (auth)

5770 (COO-2084-17) STUDIES WITH INFECTIOUS FRAGMENTS OF PHAGE DNA. Technical Progress Report, January 1, 1973-March 30, 1974. Schachtele, C. F. (Minnesota Univ., Minneapolis (USA). Dept. of Microbiology). 1974. Contract AT(11-1)-2084. 28p. Dep. NTIS $4.50.
Results are reported from studies on the small, virulent Bacillus subtilis bacteriophage φ29. Suppressor-sensitive (sus) mutants of φ29 were isolated and placed into 13 cistrons. These mutants are being integrated into a previously described temperature-sensitive mapping systems. (auth)

5771 (COO-2101-20) SYNTHESIS OF DNA CONTAINING URACIL OR 4-HYDROXYMETHYLURACIL DURING BACTERIOPHAGE INFECTION OF BACILLUS SUBTILIS. Progress Report, August 1, 1973-July 31, 1974. Price, A. R. (Michigan Univ., Ann Arbor (USA). Dept. of Biological Chemistry). 1974. Contract AT(11-1)-2101. 6p. Dep. NTIS $4.00.

5772 (COO-3115-10) GAMETIC SELECTION AS AN EVOLUTIONARY FORCE: THE MAINTENANCE OF LETHAL POLYMORPHISMS IN WILD POPULATIONS OF MUS MUSCULUS. Dunn, L. C. (Columbia Univ., Irvington-on-Hudson, N. Y. (USA). Nevis Biological Station). 1974. Contract AT(11-1)-3115. 31p. Dep. NTIS $4.75.
Several populations of wild house mice (Mus musculus) in the eastern United States were each found to be polymorphic for a lethal or semilethal allele at a locus T which had been identified in laboratory mice. (auth)

5773 (COO-3277-29) MECHANISMS OF BIOLUMINESCENCE, CHEMILUMINESCENCE, AND OF THEIR REGULATION. Progress Report, 3 Year Period Through March 1974. Seliger, H. H. (Johns Hopkins Univ., Baltimore, Md. (USA). McCollum-Pratt Inst.). 1974. Contract AT(11-1)-3277. 29p. Dep. NTIS $4.50.

5774 (COO-3280-3) BASIC MECHANISM IN CARCINOGENESIS. Progress Report, May 1973-May 1974. Ts'o, P.O.P. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1974. Contract AT(11-1)-3280. 80p. Dep. NTIS $7.00.
Progress is reported in studies on the chemistry and biochemistry of 6-hydroxyl benzo(a)pyrene, the development of an in vitro morphological transformation assay system using cultured Syrian hamster embryo (SHE) cells, studies on the physical penetration of T7 DNA into SHE cells, and the fate of T7 DNA genome inside SHE cells during continuing culture for a prolonged period of time. (CH)

5775 (ORNL-UR-116) RECONCEPTUALIZING MINORITY GROUP STATUS EFFECTS ON FERTILITY. Ritchey, P. N. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 30p. Dep. NTIS $4.50.

5776 (ORO-2401-80) UTILITY OF PLACENTAL TISSUE AS AN INDICATOR OF TRACE ELEMENT EXPOSURE TO ADULT

AND FETUS. Bagian, R. J.; Brill, A. B.; Schulert, A.; Wilson, D.; Larsen, K.; Dyer, N.; Mansour, M.; Schaffner, W.; Hoffman, L.; Davies, J. (Vanderbilt Univ., Nashville, Tenn. (USA)). 1973. Contract AT(40-1)-2401. 16p. (CONF-730802-5). Dep. NTIS $4.00.

From first annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

5777 (ORO-2410-29) NITRATE ABSORPTION AND STRONTIUM ACCUMULATION. Annual Progress Report, August 1, 1973–July 31, 1974. Jackson, W. A. (North Carolina State Univ., Raleigh (USA). Dept. of Soil Science). Apr 1974. Contract AT(40-1)-2410. 77p. Dep. NTIS $7.00.

5778 (ORO-3857-7) MOLECULAR BIOLOGY OF REOVIRUS MULTIPLICATION. Joklik, W. K. (Duke Univ., Durham, N. C. (USA). Dept. of Microbiology and Immunology). 1974. Contract AT(40-1)-3857. 50p. Dep. NTIS $5.50.

5779 (ORO-3982-27) ENZYMATIC SYNTHESIS OF EUKARYOTIC NUCLEIC ACIDS. Progress Report, August 1, 1973–July 31, 1974. Mans, R. J. (Florida Univ., Gainesville (USA). Dept. of Biochemistry). 1974. Contract AT(40-1)-3982. 5p. Dep. NTIS $4.00.

5780 (UR-3490-361) EFFECT OF SUBSTRATE DEPLETION AND LOW Po_2 ON ERYTHROCYTE MEMBRANE PERMEABILITY AND DISTENSIBILITY. LaCelle, P. L.; Hindorf, K. A.; Billingham, L. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 8p. (CONF-730858-1). Dep. NTIS $4.00.

From seventh international symposium on erythrocytes; Berlin, F. R. Germany (23 Aug 1973).

5781 (UR-3490-440) BIOLOGICAL EFFECTS OF MICROWAVES ON THE HYPOTHALAMIC/PITUITARY/THYROID AXIS. Magin, R. L.; Michaelson, S. M. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). [nd]. 4p. (CONF-740610-1). Dep. NTIS $4.00.

From G-MTT international microwave symposium; Atlanta, Georgia, USA (12 Jun 1974).

5782 (UR-3490-441) THERMOGENETIC AND CARDIODYNAMIC REGULATION IN DOGS CRANIALLY EXPOSED TO 2450 MHz (CW) MICROWAVES. Lu, S. T.; Bogardus, R.; Cohen, J.; Jones, J.; Kinnen, E.; Michaelson, S. (Rochester Univ., N. Y. (USA)). 1974. 9p. (CONF-740610-3). Dep. NTIS $4.00.

From G-MTT international microwave symposium; Atlanta, Georgia, USA (12 Jun 1974).

5783 (UR-3490-462) BIOCHEMICAL AND NEUROENDOCRINE ASPECTS OF EXPOSURE TO MICROWAVES. Michaelson, S. M.; Houk, W. M.; Lebda, N. J. A.; Lu, S. T.; Magin, R. L. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 51p. (CONF-740220-2). Dep. NTIS $5.75.

From conference on the biological effects of non-ionizing radiation; New York, New York, USA (11 Feb 1974).

Materials

5784 (AEC-tr-7541) STUDY OF DISLOCATION CLIMB BY MEANS OF DIFFUSIONAL CREEP EXPERIMENTS IN MAGNESIUM. I. Deformation Mechanism. Edelin, G.; Poirier, J. P. Translated from Phil. Mag.; 28: No. 6, 1203-1210(Dec 1973). 8p. Dep. NTIS $4.00.

5785 (AEC-tr-7543) STUDY OF DISLOCATION CLIMB BY MEANS OF DIFFUSIONAL CREEP EXPERIMENTS IN MAGNESIUM. II. Measurement of the Climb Rate. Edelin, G.; Poirier, J. P. Translated from Phil. Mag.; 28: No. 6, 1211-1223(Dec 1973). 13p. Dep. NTIS $4.00.

5786 (AERE-R-7650) GENERAL FORMULATION OF THE PROBLEM OF CALCULATING THE ENERGIES OF LATTICE DEFECTS IN IONIC CRYSTALS. Norgett, M. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1974. 52p. Dep. NTIS (U. S. Sales Only) $4.75. UK £1.00.

5787 (BDX-613-946(Rev.)) IMPACT TESTING OF FOAM-FILLED PAPER HONEYCOMB WITH ENERGY-ABSORPTION CHARACTERISTICS COMPARED TO BALSA AND REDWOOD. Final Report. Thorne, L. F.; Jump, R. D. (Bendix Corp., Kansas City, Mo. (USA)). May 1974. Contract AT(29-1)-613. 84p. Dep. NTIS $7.25.

5788 (BDX-613-1124) DEBURRING: AN ANNOTATED BIBLIOGRAPHY. Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). 1973. Contract AT(29-1)-613. 172p. (CONF-740445-4). Dep. NTIS $11.75.

From SME international tool and manufacturing show conference; Philadelphia, Pennsylvania, USA (29 Apr 1974).

5789 (BNL-18617) ISOTOPE AND CONCENTRATION MEASUREMENTS OF STRATOSPHERIC SULFATE. Castleman, A. W. Jr.; Munkelwitz, H. R.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y. (USA)). Dec 1973. 19p. (CONF-740106-1). Dep. NTIS $3.00.

From 1st special assembly of the International Association of Meteorology and Atmospheric Physics; Melbourne, Australia (14 Jan 1974).

5790 (CALT-767-P-3-33) SIMPLE TECHNIQUE FOR THE PREPARATION OF ULTRA-THIN CARBON FILMS FOR ELECTRON MICROSCOPY. Arnal, H. J.; Horgen, H. M. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). [nd]. Contract AT(04-3)-767. 6p. Dep. NTIS $4.00.

5791 (CEA-CONF-2587) CELLULAR MODEL OF ALLOYS AND ORDER OF THE MAGNETIC TRANSITIONS IN INVAR. Billard, L.; Natta, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 10p. (CONF-730977-2). Dep. NTIS (US Sales Only) $4.00.

From international conference on disordered alloys; Strasbourg, France (Sep 1973).

5792 (CEA-R-4536) HIGH TEMPERATURE CREEP OF SINGLE CRYSTALS OF GOLD, SILVER, AND SOLID SOLUTION GOLD SILVER 50-50. Dorizzi, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1974. 53p. (In French). Dep. NTIS (US Sales Only) $5.75.

Thesis. Submitted to Paris Univ., Orsay (France).

5793 (CEA-R-4554) STUDY OF ELASTOPLASTIC DEFORMATIONS OF FLAT CYLINDERS SELF-FRETTED BY MANDRELING. Caron, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Apr 1974. 172p. (In French). Dep. NTIS (US Sales Only) $11.75.

Thesis.

5794 (CONF-740424-1) RESEARCH MATERIALS INFORMATION CENTER. Connolly, T. F.; Cleland, J. W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 10p. Dep. NTIS $4.00.

From materials information programs meeting; Gaithersburg, Maryland, USA (16 Apr 1974).

5795 (COO-1198-1069) SHAPE MEMORY BEHAVIOR AND MECHANICAL CHARACTERISTICS OF SOME COPPER ZINC ALLOYS. Schroeder, T. A. (Illinois Univ., Urbana (USA)). Jun 1974. Contract AT(11-1)-1198. 78p. Dep. NTIS $7.00.

Thesis.

5796 (GIPR-97) MOESSBAUER STUDY OF SOME ALLOY SYSTEMS OF METALLURGICAL INTEREST. Solly, B. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). 1973. 76p. Dep. NTIS (U. S. Sales Only) $7.00.

Thesis. Submitted to Goteborg Univ.

5797 (GKSS-73-E-24) EXTENSION OF THE PHYSICAL CHARACTERISTICS PROGRAM FOR FREON 12. Rinne, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1973. 28p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

To decrease costs of heat transfer measurements with water in the two-phase flow region, FREON 12 is often used as a model liquid. A computer program was written that calculates for the boiling and saturated steam curve and for the superheated region the values for density, enthalpy, entropy, and boiling pressure and now these values are extended to the liquid region. The specific heat, dynamic viscosity, thermal conductivity, and surface tension are included. (GE)

5798 (ISS-P-73-7) ELECTROREFLECTANCE OF GaTe IN THE EXCITON ABSORPTION REGION. Burattini, E.; Grandolfo, M.; Ranghiasci, C. (Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 3 Sep 1973. 17p. Dep. NTIS (US Sales Only) $4.00.

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Rationalization of manufacture; manufacture of motors; winding and impregnation; spray sintering; commutators; automation of coil winding; self-supporting coils through thermoplastic wire supports; demands on lacquered wires; impregnating agents in electrical technology; and insulation of slots and of laminar bundle are subjects covered at the meeting on operations technology in which alternate methods of manufacturing coil and the technique of assembly in the electrical industry are treated. (MCW)

5822 (P.A.U.M-21) CURIOSITY ORIENTED RESEARCH: AN EXPERIMENTAL STUDY: X-RAY HOLOGRAPHY. Medford, R. D. (Programmes Analysis Unit, Chilton (UK)). 1974. 25p. Dep. NTIS (U. S. Sales Only) $4.25. UK 50 pence.

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Results of low-voltage electrical contact arcing experiments are presented. Visible arcs were detected at potentials down to, but not below, the melting potentials for various metals (0.3 to 1.1 volts), whereas the minimum voltage for arcing has been previously assumed to be 11 to 15 volts. Scanning electron microscope photomicrographs show arc pits, melting, and spattering for contacts arced at these low voltages. Circuits were designed to minimize the inductance, and oscilloscope traces of the arcing potentials were obtained. (auth)

5824 (SLA-74-5084) INTRINSIC THERMOCOUPLE RESPONSE. Keltner, N. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 6p. (CONF-740504-4). Dep. NTIS $4.00.
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From international symposium on structural mechanics software; College Park, Maryland, USA (12 Jun 1974).

Some fracture mechanics computer programs currently being used are surveyed. Most of this software represents very recent developments in computational fracture mechanics. Included are brief abstracts of computer programs that treat the characteristic near-field singularity that is present at the tip of a crack. A critical review of computational fracture mechanics is offered and some suggestions are given as to the proper selection of fracture mechanics software for a particular problem. Future trends in this field are presented. 63 references. (auth)

5826 (SLA-74-5190) THERMAL STRESS AND CREEP. Nickell, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 20p. (CONF-740604-2). Dep. NTIS $4.00.

From international symposium on structural mechanics software; College Park, Maryland, USA (12 Jun 1974).

Computer programs designed to analyze problems of time-dependent flow in solids (creep and/or recovery) are surveyed. Special attention is given to the manner in which the temperature field is supplied to the stress analysis module and to data input procedures for temperature-dependent flow parameters. The computer programs are divided into four classes, based primarily on geometrical capability: (i) historical, (ii) one-dimensional, (iii) two-dimensional, and (iv) general purpose. Algorithmic details that are particularly germane to the creep problem—such as automatic increment control, iteration within the increment based on error tolerances, tangent modulus vs. initial strain approaches, flow and hardening rules, and equations-of-state are discussed. Program sources, documentation, availability and maintenance organizations are listed. 31 references. (auth)

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From Carnahan conference on electronic crime countermeasures; Lexington, Kentucky, USA (16 Apr 1974).

5828 (SLL-73-74) TRANSIENT FORCED CONVECTION DURING DUAL-CHAMBER COMBUSTION. Landram, C. S.; Hartley, D. L. (Sandia Labs., Livermore, Calif. (USA)). Jan 1974. Contract AT(29-1)-789. 66p. (CONF-740514-1). Dep. NTIS $6.50.

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For California Univ., Livermore. Lawrence Radiation Lab.

Explicit solutions to the differential equations describing the propagation of transient pulses in lossless transmission lines consisting of two or more conductors are described. The starting point is from the differential equations. The parameters appearing in the differential equations are assumed to be known constants. Explicit solutions are valuable for the purpose of understanding the gross behavior of the signals in the ideal cases. Also explicit solutions are useful for the checking of numerical schemes and in some cases for the derivation of numerical schemes. Results are stated as theorems and are summarized for the two-line and then show how to generalize them to multilines. (auth)

5830 (UCRL-75426) EMP-INDUCED SKIN CURRENTS ON AIRCRAFT. Landt, J. A.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1974. 11p. (CONF-740602-1). Dep. NTIS $4.00.

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5831 (UCRL-75428) EVALUATION OF SOME THIN WIRE COMPUTER PROGRAMS. Poggio, A. J.; Bevensee, R. M.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1974. 10p. (CONF-740602-3). Dep. NTIS $4.00.

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5832 (UCRL-75449) MULTIWIRE BEVERAGE ANTENNA: THEORY AND EXPERIMENT. Lytle, R. J.; Lager, D. L.; Miller, E. K.; Deadrick, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Mar 1974. 5p. (CONF-740602-2). Dep. NTIS $4.00.

From G-AP international symposium; Atlanta, Georgia, USA (10 Jun 1974).

The Beverage antenna was studied from a theoretical viewpoint and the basic nature of operation. The antenna performance depends upon the antenna length, the height above ground, the spacing and configuration of wires (e.g., parallel or diamond shaped, multiple or a single wire), the ground conductivity and dielectric constant, and the frequency. (MCW)

5833 (UCRL-75635) FIRE HYDRAULICS IN THE FIRE SCIENCE CURRICULUM. Purington, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). [nd]. 4p. (CONF-740420-1). Dep. NTIS $4.00.

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From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

A high temperature, high pressure furnace was designed and constructed for an existing 9-inch I.D. × 30-inch deep vertical standing pressure vessel to obtain a 3-inch diameter × 6-inch long hot zone for 1750°C and 20,000 psi operation with argon. The furnace design is of the multiwall bell-type concept eliminating convection flow heat losses and reducing almost completely erosion due to thermal currents. (auth)

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